THE AMERICAN

GAS LIGHT JOURNAL

INC.

PUBLISHED WEEKLY, AT 42 PINE ST.

VOLUME CIII. No. 8.
Whole No. 2,098.

NEW YORK, MONDAY, AUGUST 23, 1915.

Subscription, $3 Per Year.
$4 Canada, $5 Foreign.

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DETERIORATION OF FIRECLAY GOODS IN OVENS AND RETORTS.

From the Article by THOS. HOLGATE in "Gas World," London.

At the 1914 meeting of the Institution of Gas Engineers a question that aroused considerable interest was that of the damage to retorts or firebricks, caused by the presence of "salt" in the coals carbonized. Subsequent discussion has tended to enlarge the interpretation of "salt" beyond sodium chloride, and has introduced the phenomenon of disintegration by carbon. The examples of this corrosion are in most cases stated in a fragmentary manner, making it difficult to locate the causes of apparently contradictory experiences and opposed explanations. It is the aim of this paper to get as much as possible of the facts, and see whether they can be reconciled, or at least furnish a starting point for further observation. The complexity of the subject makes it necessary to subdivide, and it is proposed to do this in two ways. First, as to retorts, distinct from coke ovens; and secondly, as to the fusion of bricks as distinct from their disintegration. It will help to a clearer understanding of the problem if a statement of the published facts be made, before attempting an explanation.

In 1910 there appeared in "Stahl und Eisen" an account of investigations by F. Schreiber, of Waldenburg, Silesia, into "the destruction of coke oven bricks and their causes." Schreiber gives, among his illustrations, a photograph of a chamber that had been heated very irregularly, and another that had been heated uniformly. In the former the bricks were much distorted and disintegrated, whilst those of the latter were better preserved. The effects of common salt, and other soluble salts, are discussed in the paper, and an illustration of a brick in its original condition, and after the working of the sodium salt, is given. The effects of carbon deposits upon bricks is referred to, and a brick from a coke oven that had cracked, owing to the formation of free carbon, is specifically considered. From the illustration thereof, it is seen that the deposit formed a black, wavy band, 20 mm. wide, within the middle third of the brick, one side of which band was 40mm. from one edge, and the other side 15 mm. from the other edge of the brick—in all 75 mm.=3 inches nearly. It is thus described: "The examination of a piece of coke oven brick from a Westphalian works revealed a peculiar carbon deposit. A black layer, 20 mm. thick, entirely symmetrical and clearly outlined, and running through the piece of brick with uniform thickness. The separate layers of the brick showed this composition. (See Table I.)

It is described as "symmetrically limited carbon deposition in a chamber brick produced by diffused pyrogenically decomposed hydrocarbons." It is also stated that silica bricks may be destroyed in a similar manner.

Upon the general question, one opinion was that the deterioration was caused by chemical action, to counteract which the addition of silica to the coal is recommended, whilst the mixing of different kinds of coking coal in the charge might have a beneficial effect.

In 1913, Professor Oskar Simmersbach, of Breslau, contributed to "Stahl und Eisen" two papers, and of which, "The Change in the Chemical Composition of Coke Oven Brickwork," we now give complete: "Towards the molecular deposition of carbon in coke oven bricks through pyrogenic decomposition of the hydrocarbons, and thence originating the loosening of the brick construction, especially with acid material, F. Schreiber has drawn attention to the possibility that even volatile iron combinations, *e. g.*, iron carbonyl $Fe(CO)_5$, may exert the influence on the quality of the bricks, as in Fig. 1 (in the original) of a coke oven brick shows. From this results a direct decrease of the iron content from the hot-wall layer to the chamber-side layer. F. Schreiber, according to private information, in various experiments, demonstrated a change of iron contents, but only in the last layer of the heat-chamber side.

TABLE I.—*Change in a Coke Oven Brick.*

Name of Oxide and Chemical Formula.	Upper Layer, 40 mm, of Brick. Percentage Composition.		Inner Black Layer in Brick. 20 mm. thick. Percentage Composition.		Lower Layer of Brick which has been slightly eaten into. 15 mm, thick. Percentage Composition.	
	As taken from Oven.	After removal of Carbon.	As taken from Oven	After removal of Carbon.	As taken from Oven.	After removal of Carbon.
Silica, SiO_2....	83.77	83.99	80.00	85.24	83.35	83.53
Alumina, Al_2O_3.	12.69	12.72	11.08	11.81	12.73	12.76
Ferric oxide, Fe_2O_3.....	1.16	1.16	0.67	0.71	1.15	1.15
Magnesia, CaO.	0.24	0.24	0.23	0.15	0.23	0 23
Lime, MgO....	0.42	0.42	0.29	0.31	0.32	0.32
Potash, K_2O...	1.56	1.57	1.58	1.68	2.01	2.01
Carbon	0.26	....	6.15	....	0.21	....
Total.....	100.10	100.10	100.00	100.00	100.00	100.00
Ratio of Weight of SiO_2 to Al_2O_3.....	6.60	6.60	7.22	7.22	6.55	6.55

"The reason for this might, apart from brick material, be due to working conditions. The pressure in the oven chamber at the beginning of coking is quite different from that toward the end of the distillation, for at the beginning, because of the strong gas development, there is over-pressure in the chamber. Especially with coal rich in gas there is at the commencement strong over-pressure, so that then also the iron-carbon combinations towards the heating wall side can exert their effect on the brick material, whereas with the finish of the coking, with regard to the more or less existing porosity in the side walls, the procedure can be taken in the opposite direction."

The Fig. 1 consists of a photograph designated "change in a coke oven brick," and the chamber side and the heating wall side are designated. The width of the brick is 12 cm., a little more than 4½"; and alongside the photograph is the following table, a partial analysis of each of five successive parts of this brick. The section marked I was compact, whilst that marked V was very much disintegrated, some parts having disappeared. (See Table II.)

Simmersbach refers to a paper "The Sulphur Content of Coal and Coke" for collateral evidence as to the instrumentality of iron carbonyl. In tracing the origin of the sulphur he found that in the various cokes examined that element appeared to be mainly from an organic source. Allied to this sulphur content was the one of iron content, because such a large proportion of sulphur is due to iron pyrites. He noticed that the results he obtained for iron content of coke, and of the coal from which the coke was ob-

tained, did not agree. And this difference he attributes to the formation and loss of iron in the form of volatile compounds such as the carbonyls. He adduces, in support of his view, experimental

TABLE II.—*Showing Change in Coke-Oven Brick.*

Place of Separation in Centimeters.	Number of Piece of Brick.	Iron Per Cent.	Carbon Per Cent.	Sulphur Per Cent.
12.0				
	V	1.18	0.193	0.077
8.0				
	IV	1.24	0.026	0.025
7.0				
	III	1.27	0.036	0.004
4.5				
	II	1.47	0.041	0.004
0.5				
	I	2.51	0.075	0.053
0.0				

NOTE.—The chamber side of the brick is at the place marked 12 centimeters, whilst the heating-wall side is at the place marked 0.0.

data of Mr. W. A. Bradbury, who, in 1878, recorded the disparity in the iron content of the ash and of the coal from whence it came. Herr Simmersbach then says: "That iron carbonyl or similar compounds are as a matter of fact, found in coke ovens no longer maintain that uniformity in the percentage of iron in them first—the bricks on the heated sides of the ovens showing a considerable increase in their percentage of iron. This increase can be explained only in the following way: Volatile iron compounds, varying in amount with the pressure of gas in the oven, pass through the pores of the chamotte from the side of the chamber to the side that gets heated; there these volatile iron compounds were decomposed (literally, burned up) and deposited their iron. When the quantity of air available is large, but not adequate for rapid decomposition (literally, burning away)—and this is the case when coal testing by incineration in the gas-muffle—then, for this reason, iron carbonyl can very readily be formed in fairly large quantities."

In October, 1913, in "The Times," Engineering Supplement, Herr Zinck, of Halberstadt, was quoted, under the heading "Corrosion of Gas Retorts," as the authority for the following: All coals contain a certain amount of sodium chloride, and apparently when this is decomposed, the basic salt (sodium hydrate) combines with the surface of the retorts and bricks, thus forming an injurious coating on the interior. The coating, being sensitive to the variations of temperature, cracks and opens, so that further quantities of the harmful fumes can enter, and in time the retort becomes covered with a crumbling substance of low fusing point. In the affected portions the proportion of silica is reduced by as much as 6%, while the harmful alkali impurities are increased by over 3%, this greatly aggrevating the tendency of the material to "run." Fortunately the majority of gas making coals in general use contain only small quantities of sodium chloride, and thus the effect is not practically marked. This, no doubt, is the reason why the action has escaped notice up to the present. Experiments carried out in a coke oven plant showed that the use of 0.143% of salt in the water for washing the coal ruins the retort in 3 years, whilst 0.036% renders a refractory substance of little value after 5 years.

English Experiences and Opinions.—In June, 1914, Mr. T. J. Bywater, stated this corrosion due to salt "to be a very important matter, because he had seen retorts fused on the inside which were quite good on the outside, where they were exposed to the gas." At the same time, Mr. W. Chaney said that "in all coals we are dealing with in carbonization there is a constantly varying quantity of salt, and no matter how highly refractory the material may be, it seems that we should aim to get a substance which will withstand the action of salt. I understand that in America something has been done in this direction, and that they have been able to find a material which is not only highly refractory, but sufficiently suitable to withstand the effects of the salt. It is a lime-bound brick, instead of the usual clay-bound; and 10 tons of coal are capable of being carbonized within 16 hours."

In October, 1914, an anonymous writer in the "Journal of Gas Lighting," whom, for brevity, we donate as "E. C.," referring to the serious corrosion of fire bricks in coke ovens, said that it is confined to certain districts, and its causes are usually regarded as the alkaline constituents of the coal, principally as sodium and potassium chlorides. "It does seem, however, to have been fairly definitely established that the corrosion is much more marked when fire bricks containing a high percentage of alumina are employed. This seems as if the salt in the coal attacked the alumina, and hence caused disintergation of the brick. When bricks containing 90 to 95% of silica are employed, the corrosion is much less marked, and the absence of alumina in such bricks seems to be a confirmation of the theory that it is the alumina which is attacked."

Later, in the same journal, Mr. W. Colquhoun challenges the main contention just set forth, saying, "It is not 'definitely established' that corrosion of coke oven bricks is more marked when the bricks contain a high percentage of alumina, but the exact contrary." Thus, in South Yorkshire, where the coal is high in sodium, we find high fixed ammonia in the liquor, and oven brickwork with a very short life, owing to fusion, The change that takes place in the brick is shown in the following analysis of a brick strongly attacked and vitrified on its face by the action of the salt. It is quite clear that alumina does not enter into the changes that occur, and that potassium and sodium disintergrate the bricks by the production of a fusible silicate. It has been shown in "Stahl and Eisen," (Mr. Colquhoun doubtless referring to F. Schreiber's paper mentioned above), that the resistance of bricks to corrosion increases directly with the contents of alumina

TABLE III.—*Another Example of Change in Brick.*

	The Solid Unvitrified Portion of Brick.	The Vitrified Face of Brick.	Difference.
Silica, SiO_2	82.20	74.90	— 7.3
Ferricoxide and alumina	13.40	13.20	— 0.2
Lime, CaO	1.60	2.00	+ 0.4
Magnesia, MgO	0.40	0.70	+ 0.3
Potash, K_2O	0.40	4.35	+ 3.95
Soda, Na_2O	0.25	2.65	+ 2.40
Loss by ignition	0.10	1.00	+ 0.90
Total accounted for	98.35	98.80	....
Ratio SiO_2 to Fe_2O_3 and Al_2O_3	6.134	5.674	— 0.46

No explanation has been found for the following fact: At colliery A, with 9.35% of NaCl in the coal, there is no attack of the bricks; at colliery B, in the same county, there is found only 0.132%; and the ovens have to be relined every two years. "In the United States, it must be remembered that the coking coals are dry (not washed) and low in alkalies. While lime-bound silica is the standard material there for coke oven construction, it has yet to be shown that it is suitable for the coking of washed coal, and suitable, also, for use with 'salty' coal."

The writer, "E. C." replied to Mr. Coloquhoun, reiterating his opinion, and saying. "But I make a distinction between vitrification and corrosion; and I have it on the authority of a responsible party, that bricks containing 92% of silica have suffered no corrosion, while bricks containing 80% have crumbled away."

Mr. Chaney also replied to Mr. Colquhoun's letter, stating his experience that the corrosion is less when a highly silicious brick is employed. This was most noticeable in an oven partly constructed of highly silicious bricks from the Continent, and English bricks containing about 14% of alumina. The two types of bricks were chequered in the oven, and the corrosion in the material containing alumina was most marked, while the silica was intact. It may be that the refractoriness of the material plays an important part in the action of the salt, when combined with the wet coal and time of contact; but it demonstrates that the lime-bound silicious brick is more suitable to withstand the combined circumstances applicable to coke oven practice.

In January, 1915, Mr. Colquhoun refers "to a phenomenon known, but not frequent, in coke oven practice, namely, the deposition of carbon in the pores of the brick, leading to its ultimate destruction. This occurrence is not unknown in gas-works practice, and certainly does not bear on the subject 'E. C.' originally introduced, when he stated that corrosion is more marked in bricks containing a high percentage of alumina. On the contrary, the resistance to salt increases directly with the alumina contents, and as the brick becomes less acid and more basic. Kaolin and other bricks high in alumnia are in extensive use in eastern Germany, coking salty coals; and they perfectly resist the action of salt. Aluminous bricks have qualities other than the resistance to salt, which render them less suitable than quartzite bricks for coke oven work. One of the most resistent bricks in a highly 'salty' neighborhood is the silicious brick, of which an analysis is given above. There are factors as important as analysis, of course, but of these we have only a vague knowledge.

TABLE IV.—*Showing Changes in Firebrick, where Alumina has Disappeared more Largely than Silica.*

	Cupola Brick.			Brick from a Briquetting Furnace.		Coke Oven Bricks.				Silica Bricks (Chequer Bricks).			
										From Gas Flue.		From Air Flue.	
	Core.	Intermediate.	Slag.	Core.	Slag.	Core.	Warty Fused Crust.	Core.	Corroded Portion.	Core.	Slag.	Core.	Slag.
SiO_2	64.13	63.95	52.10	70.93	67.07	83.72	82.85	82.87	77.31	90.14	73.94	92.01	86.91
Al_2O_3	29.61	29.67	19.81	24.68	21.52	12.43	11.55	13.52	11.04	4.06	2.73	2.94	2.45
Fe_2O_3	1.89	1.93	1.39	1.48	5.02	0.98	1.00	1.15	3.71	1.98	10.81	1.94	6.25
CaO	0.80	1.10	0.52	0.15	0.90	0.15	0.27	0.26	2.00	2.66	4.24	1.90	1.10
MgO	0.72	0.75	0.47	0.19	0.54	0.24	0.32	0.31	0.81	0.17	0.91	0.21	0.19
K_2O	2.85	2.50	3.90	2.23	4.65	2.48	4.01	1.44	4.38	0.99	6.37	1.00	3.10
CuO	....	0.10	21.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lost in calcination	....	.....	0.15	0.34	0.30	.....	.....	0.45	0.80	.....	.....	.....	.....
$SiO_2 \div Al_2O_3$	2.166	2.155	2.63	2.875	3.12	6.735	7.173	6.129	7.003	22.20	27.08	31.29	35.47

TABLE V.—*Compiled from the Data of Dr. Blasberg, Relative to a Silica Brick, showing Accretions and Depletion.*

Components (Sodium Included as an Equivalent of Potassium).	Intact Core.	Strongly Corroded.	Black Portion, White Grains Showing.	Grey Portion, Grains Vanished.	Crystalline Outside Layer.	Exclusive of the Manganic Oxide.	Exclusive of Ferric Oxide and Manganic Oxide		Exclusive of Lime, Ferric Oxide and Manganic Oxide.		Exclusive of Alkalies, Magnesia, Lime, Ferric Oxide and Manganic Oxide	
	a	*b*	*c*	*d*	*e*	*e*	*a*	*e*	*a*	*e*	*a*	*e*
SiO_2	95.94	89.38	90.13	89.60	69.87	75.210	97.016	88.950	98.31	95.050	98 47	97.20
Al_2O_3	1.50	3.47	2.52	1.33	2.01	2.163	1.517	2.558	1.53	2.705	11.53	2.80
Fe_2O_3	1.11	2.73	3.80	5.15	14.35	15.446	.....	.....	.....	.....	.....	.....
CaO	1.30	3.80	2.52	2.18	4.26	4.586	1.315	5.423	.....	.....	.....	.....
MgO	0.11	0.24	0.75	1.00	1.14	1.228	0.112	1.452	0.115	1.535	.....	.....
K_2O	0.04	0.38	0.24	0.62	1.27	1.367	0.040	1.617	0.045	1.710	.....	.....
Mn_3O_4	.....	.....	.....	.....	7.10	.....	.....	.....	.....	.....	.....	.....
Loss in calcinations	.....	.....	0.04	0.12	.....	.....	.....	.....	.....	.....	.....	.....
$SiO_2 \div Al_2O_3$	63.96	25.76	35.77	67.37	34.76	34.76	63.96	34.76	63.96	54.76	63.96	34.76
Column number	1	2	3	4	5	6	7	8	9	10	11	12

TABLE VI.—*Showing the Accretion of Alkalies and Depletion of Alumina, etc., in Cupola Brick, per Table IV.*

Components. (Sodium Included as an Equivalent of Potassium.)	Exclusive of Copper Oxide.		Exclusive of Copper Oxide and Alkalies		Change per Cent. of Original Percentages.	Exclusive of Copper Oxide, Alkalies, Lime and Magnesia.		Exclusive of Copper Oxide, Alkalies, Lime, Magnesia and Ferric Oxide.	
	Core	Slag.							
	a	*c*	*a*	*c*		*a*	*c*	*a*	*c*
SiO_2	64.13	66.63	66.01	70.13	+ $6\frac{1}{4}$	67.06	71.07	68.42	72.45
Al_2O_3	29.61	25.34	30.47	26.67	—$12\frac{1}{2}$	30.95	27.03	31.53	27.55
Fe_2O_3	1.89	1.775	1.95	1.87	— 4	1.99	1.90	.....	.....
CaO	0.80	0.665	0.82	0.70	—15	.....	.....	.....	.....
MgO	0.72	0.60	0.74	0.63	—15	.....	.....	.....	.....
K_2O	2.85	4.99	.....	.....	.....	.....	.....	.....	.....
$SiO_2 \div Al_2O_3$	2.166	2.63	2.166	2.63	.....	.....	.....	.....	.....
Column number	1	2	3	4	5	6	7	8	9

Having set forth the problem we proceed to investigate various data and to consider the various chemical and physical factors, to see how far they confirm the experiences described.

I.—THE RESISTANCE TO CHANGE OF SILICA AND ALUMINA CONTENT.

At the International Congress of Mining Engineers, in 1910, Dr. Eugen Blasberg read a paper on "Changes in the Composition of Fire Bricks." There are ninety analyses of bricks tabulated in the paper, under three classes: (1) bricks from blast furnaces, cupolas, etc.; (2) coke oven bricks; silica bricks. Many of these are in sets, that is, they are analyses of parts of the same brick, some of which are believed to be unchanged and others obviously changed. The writer has taken all these analyses, and others, and computed the ratio by weight of the $SiO_2 \div Al_2O_3$ (silica to alumina ratio). This has been done to find out if there was any loss of alumina to be traced in the different specimens. A number of cases show a unmistakable loss of alumina. It is known to those who have studied the interpretion of such analyses that, owing to the obvious accession of certain ingredients and the obvious depletion of others, it is not easy to see whether the remaining ingredients have been affected merely by this redistribution, or whether they also have been depleted or their content increased. The importance of this consideration is great, relative to the silica and alumina content, but it can be met by the device of comparing the silica-alumina ratio before and after a supposed change. This ratio will, of course, only tell us whether the silica or alumina have disappeared most, but this information will be very useful, and appears to be unequivocal. Out of 32 comparisons, 22 examples show the silica content to have disappeared most; 7, the alumina to have disappeared most, and 3 where the removal of silica and alumina has been about the same. In none of the investigations that the writer has studied, is there any allusion to an actual loss of alumina, or to a relative loss thereof; but the evidence of Table IV appears to be conclusive on this point, and leads to the question as to how the loss is effected. It is true that Mr. Chaney refers to the alumina being "attacked," but this does not appear to be

synonymous with loss, as will presently be seen. The analyses furnished by Mr. Colquhoun show, by the ratio computed by the author, that, in this specimen, a loss of silica has occurred, that is if the combination of the ferric oxide with the alumina in his figures does not lead us astray.

Table IV. gives the source and composition of six bricks that show a greater loss of alumina than of silica, manifest by the rise in the ratio, *i. e.*, the $SiO_2 \div Al_2O_3$; and Table V gives particulars of a silica brick that shows both classes of change in the analyses of its five sections; while Table VI. shows the lessons to be obtained by comparing the first and third columns of Table IV.

Table V. shows how, by a successive elimination from the computation of each oxide of an element, the various changes can be elucidated, concluding in the last two columns with the percentages of the silica and alumina in the two specimens of the silica brick, *a* and *e*. This comparison shows that *e* has lost silica and, consequently, appears to have gained in alumina, markedly brought into prominence by the change of ratio from 63.96 to 34.76. If a similar comparison be made between *a* and *d*, we shall perceive a change in the reverse direction. The first fact to note in reference to analysis *e*, column 5, is an absorption of manganic oxide (Mn_3O_4), and when this is removed from the computation, so as to eliminate a manifest acctetion, we obtain column 6, which, in turn, shows, by accentuation, other accretions in ferric oxide, the alkaline earths and the alkalies. Removing the first named, we obtain columns 7 and 8, which show very large accretions of the alkalies and alkaline earths. Removing lime, we obtain columns 9 and 10, which show the accretions of magnesia, potash and soda in their true relations. [Although these accretions of the alkalies are large, they are surpassed by some found in the coke oven bricks of of an English gasworks.] Finally, in columns 11 and 12 we have the silica and alumina content, showing that a relatively small loss of silica makes an apparent rise in alumina, defined by the ratio changing from 63.96 to 34.76. Of the five portions of this silica brick, the only one showing manganese is *e*, the crystalline outside layer, and this accretion has probably intensified chemical action, accelerating the other accretions, notably ferric oxide, the alkaline earths (lime and magnesia), and potash with soda.

Applying this mode of inquiry to the other portions, we find that specimen *d* shows no diminution of silica, but a slight loss of alumina, though the figures of 98.47 SiO_2 and 1.53 Al_2O_3 far the intact specimen *a*, and 98.54 SiO_2 and 1.46 Al_2O_3 for *d*, shows that in reality the silica and alumina contents have changed little, if at all. This fact is not obvious on inspection of the analytical data, and is perhaps too sharply accentuated by a change of ratio, but the ultimate percentages place the matter in its true light. The several portions thus examined give the ultimate percentages set out below, showing silica loss from *b*, *c* and *e*, and neither silica nor alumina appreciably removed from *d*. Of *b*, it must be remarked that with less accretions than in the case of *e*, there is greater loss of silica, agreeing with the description of its being strongly corroded.

Sil'ca Brick as in Table V.	Ultimate Percentages of the Five Portions of Brick.				
	a	*b*	*c*	*d*	*e*
Silica	98.47	96.26	97,39	98.74	97.2
Alumina	1.53	3.74	2.61	1.46	2.8

Having shown the utility of the method, we must now apply it to a case of the class where alumina has been lost in notable degrees, *e.g.*, the cupola brick of Table IV. The three portions thereof, are *a*, the apparently unchanged; *b*, just beginning to change; and *c*, the highly changed, with a marked accession of copper oxide.

Only *a* and *c* need be dissected, and doing so will show the changed aspect of the analysis when the copper oxide is eliminated, and the incidence of the potash and soda accretion. These are shown in columns 1 and 2 of Table VI, then in 3 and 4, while in column 5 it is shown that, relatively, rather more lime than magnesia, viz., 15%, each has been lost than alumina—12.5%. Continuing, we find in columns 6 and 7, that the loss of ferric oxide has been, relatively, smaller than the loss of alumina, whilst in columns 8 and 9, we see that a loss of 12.79% of the original alumina—from 31.58 to 27.55—has brought about the apparent rise of 5.89% of the original silica from 68.42 to 72.45. The clue to this loss of alumina is in the change of ratio from 2.166 for specmen *a*, to 2.63 for specimen *c*, and its magnitude expressed as percentages is seen in columns 8 and 9 of Table VI. Proceeding to the remaining specimens of Table VI, and computing in the manner just shown, we obtain the results in table VII, which shows the amount of alumina in each 100 parts of silica-alumina before and after the use of the brick; and in the last column the percentage of loss of the alumina over that of silica (if any) based upon its original centent.

TABDE VII.—*Showing the Change in the Composition of Bricks, when the Impurities and Accessories are Eliminated from the Analysis.*

Nature and Source of Brick, per Table IV.	Percentage of Alumina in the Silica-Alumina part of the Brick			Alumina Lost in Percentages of Original (Intact) Content.
	Intact.	Changed.	Difference.	
Cupola brick	31.58	27.55	4.030	12.79
Briquetting furnace brick	25.807	24.272	1.535	5.95
Coke oven brick	12.928	12.235	0.693	5.45
" " "	14.027	12.495	1.532	10.92
Silica chequer bricks — from gas flue	3.855	3.561	0.324	8.34
Silica chequer bricks — from air flue	3.097	2.750	0.347	11.21

The loss of alumina in each of these six specimens is pronounced, and appears relatively almost as great with the one containing the least alumina originally as with the one containing the most. The dirvisity of working conditions is as large as that of the chemical composition, and the evidence appears to be conclusive, however unexpected, that under certain circumstances alumina is lost from fire bricks.

II.—The Changes in Bricks of the Birmington Coke Ovens.

We now look to see how the foregoing facts stand in relation to Mr. Chaney's experience. A brick before use contained 75% of SiO_2 and 21.6 of Al_2O_3, which in time was reduced to 55.8 of silica and increased to 41.37 of alumina. The important fact is here revealed that the brick relatively rich in alumina, which Mr. Chaney finds has suffered more than the one relatively rich in alumina, has perished not by loss of alumina, but by loss of silica. Dealing with these figures, similarly to Table VI, we find that, excluding all other constituents, the comparison stands as follows:

	Before Use.	After Use.
Silica	77.64	57.43
Alumina	22.36	42.57
Ratio	3.472	1.349

The contrast is so great that it at once raises the question as to how the presence of alumina can contribute to a chemical action that results in the loss of silica. If the analysis were more complete, we might be able to trace some clue, but in the absence of such information, we must direct attention to another brick, of which Mr. Chaney gives the following particulars. Analysis of the surface of fire brick: The original material contained 70% of silica and 0.7% of sodium or potassium chlorides. At the end of two years the potassium and sodium chlorides had increased to 8.4%, and the structure of the brick on the surface was destroyed. The accession of alkalies agrees broadly with the large amount given by Mr. Colquhoun, when one remembers that Mr. Chaney's figures are expressed as chlorides, whilst Mr. Colquhoun's are as oxides. It will be noted that this brick contains less silica than the one previously mentioned by 5%, and presumably more alumina, but in the absence of a complete analysis the ratio of SiO_2 to Al_2O_3 cannot be discussed. The remarkable accession of the chlorides, and the well-known chemical activity of aluminum chloride, lead one to inquire whether the last-named substance may be an intermediary in the mischief.

There are reasons, based upon the facts set forth in our introduction, why we should not exclude from consideration the oxide of carbon, the hydrocarbons and water present in the coke oven or the heating flue (which questions are discussed later); and towards these gases aluminium chloride is a powerful catalyst.

III.—The Role of Aluminium Chloride, Carbide, Etc.

The last edition of the Encyclopædia Britannica states, "As a synthetical agent in organic chemistry, aluminium chloride has rendered possible more reactions than any other substance; here we can only mention the classic synthesis of benzene homologues." To the modern chemist the acceleration of chemical action, by the presence of aluminium chloride, is known as the "Friedel and Crafts' reaction," and during recent years much attention has been paid to determine the conditions under which the greatest speed of reaction takes place. There are many points as yet unsettled, but two are apparently established, viz., (*a*) that the accelerating effect of aluminium chloride is roughly in proportion to the quantity present; (*b*) that if the aluminum chloride enter into certain combinations, its effect upon surrounding substances is diminished. The importance of the first of these points, in relation to the pres-

ent discussion, is obvious, for although many of the chemical reactions induced by aluminium chloride leave the quantity of that substance free and unchanged, yet the quantity present does effect the rate at which the reaction will proceed. This is a factor that must be borne in mind, because the conditions inside the retort or coke oven are constantly varying, and time is of the essence for carrying out of a particular reaction. Of the second point, it must be noted that circumstances in certain retorts may be such as to favor combination, whilst in others not, bringing about a contradiction in results where, apparently, the same conditions prevail. One particularly well-known combination of aluminia chloride, viz., that with common salt, forming the double chloride of aluminium and sodium (Al_2Cl_6, 2NaCl), is most likely to occur. If it does, we have a substance which melts at 185° C., and volatilizes at a red heat. Moreover, it may reasonably be inferred that it would react with silica, producing the readily fusible silicate of sodium, accounting for the loss of silica. The behavior of aluminium chloride depends, in some cases, upon its being anhydrous—that is, after a charge of wet coal, its effect might differ from what it would be later, when all moisture had been expelled by heat.

Schrieber and Simmersbach have referred to the effect of metallic carbonyls as did, at a prior date, Mr. Frank Firmstone, but, so far, a carbonyl of aluminium has not yet been found, whilst on the other hand the carbide (Al_4C_3) does exist. It has properties of importance in this connection, for it is formed by the action of carbon, or the oxides of carbon, on alumina at very high temperatures, and is remarkable as being staple at high temperatures, and yet undergoing decomposition at a dull red heat. In contact with water or dilute acids, it reacts slowly with the production of methane. Up to 1,400° C. the carbide acts as a reducing agent on metallic oxides, and this may operate on the oxides of iron present in fire bricks.

The behavior of alumina towards carbon and carbon monoxide is largely conditioned by the temperature, and at the higher temperatures aluminium reacts with metals, producing an alloy. The oppositeness of this reaction is seen in the case (see Table IV and detail in Table VI) where alumina was removed from the brick where copper had gained access to the walls of the furnace.

It is desirable here to note that when carbon bisulphide vapor is passing over strongly heated alumina, aluminium sulphide (Al_2S_3) results. It forms a yellow fusible mass, which is decomposed by water into alumina and sulphuretted hydrogen.

IV.—The Role of Iron Carbonyl.

In his explanation of the variation of iron content in the 5 parts of a brick, Simmersbach refers to volotile metallic carbonyls, meaning, doubtless, those of iron, and specifying one as $Fe(CO)_3$. This formula is probably a slip of the pen, for the three known are the tetracarbonyl, $Fe(CO)_4$, the penta, $Fe(CO)_5$, and the differo-nona, $Fe_2(CO)_9$. The penta carbonyl is the one best known, and is the one proved to be present in coal gas, and, to a greater extent, in water gas. It is produced, at a low temperature, by the action of carbon monoxide on finely divided iron, yielding a liquid that boils at 103° C. One property that must be noted here is that it is diamagnetic.

Neither Schrieber nor Simmersbach, in the papers quoted, give experimental proof that the loss of iron and the accession of carbon are due to the agency of iron carbonyl, but the conjecture appears not unreasonable, for Fe(CO) could be produced at a low temperature and decomposed at a high one, with separation of iron and carbon monoxide. From the latter could come finely divided carbon—from combustion in an atmosphere deficient in oxygen, and also by reaction with iron in its various forms of oxidation, and at suitable temperatures, usually of a moderate order. The figures given by Simmersbach (Table II) show with depletion in iron a notable accession of carbon, and a smaller one of sulphur on the chamber side, as against the heating wall side, but this degree of change is not the same as shown by the three intervening layers. What appears to be the important factor in the case, is the moving about of the iron and the carbon in the brick, whether iron carbonyl is the intermediary or not. The reduction in the state of oxidation of the iron of itself spells increased fusibility, while the carbon deposits mean disruption, allowing hostile influences to gain easy entrance to the brick. Further, the finely divided carbon is itself a powerful reducing agent upon oxides of iron, and would accentuate the mischief.

V.—The Effect of Iron as a Flux, in Relation to Silica and Alumina Content.

The injurious effect of iron just discussed must be considered as affected by different ratios of alumina and silica. It is known to clay workers that a given amount of ferric oxide would promote fusibility in a different degree, according to the presence of other fluxes, and also to the ratios of the concomitant alumina and silica. This last named phenomenon has been quantitatively examined by Mr. C. S. Kinnison. Ferric oxide cannot exist above 1,350° C., but dissociates into oxygen and magnetic oxide, which latter, in presence of silica, as in clay, forms ferrous silicates, dark brown to black in color. This color change was taken as criterion of the reduction of ferric oxide when added to various clays. The results show the temperature of formation of ferrous silicate is qualified by the $SiO_2 \div Al_2O_3$ ratio of the body mixture, the greater the quotient of the $SiO_2 \div Al_2O_3$, the lower the temperature. The tests were carried out on mixtures where the ratio, as just defined, varied from 2 up to 9. Thus, in acid clays, reduction of Fe_2O_3 takes place at lower temperatures than in more aluminous bodies—1,320° as compared with 1,390° C.; and when fluxes are present the dissociation temperature is 1,210° to 1,220° C. The application of this recently acquired data to our problem would be that if a silica brick, either by its original or acquired iron content, contained as much thereof as a more aluminous brick, fusibility would be increased to a greater extent.

VI.—The Tendency of Silica to Change Its Volume.

The quality of a silica brick is not wholly—although largely—defined by its chemical analysis or melting point, for, according to K. Endell, the best samples of raw material contain a siliceous cement, which can be detected by the microscope, and which binds the quartz grains together. "Owing to the fine state of division of any impurities, such quartz possesses considerable mechanical strength, and increases markedly in volume upon the first ignition. The silica content should average 96 to 98%." It is desirable to examine this statement, so that we may perceive their true bearing—and that of other quotations—upon our problem. And, first, we must try to avoid confusion in the use of a term employed in our introduction by Mr. W. Colquhoun, viz., vitrification. He presumably used it to denote that the surface of the bricks had been fused, and the material had "run." In ordinary commercial language, to say that a building brick had a vitrified surface is to imply, not a defect, but a good quality; whilst in scientific descriptions it is employed to denote the change of form from the crystalline to the amorphous—that is, from a granular to a glassy texture. It denotes a changed appearance, whether that be brought about by heat or by some other agency. The term is used in this last sense in the quotation we now give from R. Rieke and K. Endell: "All kinds of quartz glass devitrify and become crystalline on long heating at a high temperature. The resulting product is crystobalite, and the degree of devitrification may be ascertained by density determinations, the specific gravity of silica being 2.21 and of cristobalite 2.33. The extent of the change is dependent on temperature, time and surface. Under 1,200° C. it requires many hours to become apparent; towards 1.685° C. the melting point of crystobalite, it is nearly proportional to the length of heating. The least tendency to crystallization is shown by quartz glasses, which are quite clear and transparent and free from bubbles. Surface impurities held in suspension conduce to devitrification. The phenomenon is prejudicial, as it causes brittleness and premeability to gases, the transformation from silica to cristobalite being accompanied by a contraction of 5% in volume. At 230° C., in cooling, β cristobalite, the regular crystalline form, changes into the α variety, which accentuates devitrification."

K. Endell has given a series of photomicrographs of various silicas, showing which are most suitable for brickmaking, and these show the cement, the quartz, tridymite and cristobalite (three different crystalline forms of silica), and the effects thereupon of heating to 1,450° C. One of these shows a specimen of first-class material heated five times to 1,450° C., disclosing innumerable minute cracks, or fissures, passing through the cristobalite ground mass.

This valuable information is obviously most applicable to the manufacture and use of high percentage silica bricks, and in considering in what degree it can be predicted of others, it must be remembered that experience has shown that some of the properties can be modified by an intelligent blending of alumina therewith. All the evidence that we have marshalled leads to the conclusion that, whilst silica can be lost from coke oven bricks by fusion, yet it may be accompanied by disintegration brought about by depositions within the pores of the material. If, then, these hostile forces can be kept outside the brick by means of a close, homogenous surface, much would be gained. It is not only the chemical nature of silica, but also the physical, that constitutes a fundamental difficulty, and we do not know that the admixture of alumina may not, at certain concentrations, introduce disturbing factors.

VII.—Carbon Deposits Due to Imperfections in the Heating Arrangements.

Some of the cases of coke oven trouble have been attributed to unequal heating, and this, whilst introducing mechanical stress by unequal expansion, may simultaneously bring about incomplete combustion in certain parts of the heating flues, tending to cause carbon deposits. These troublesome things may arise where the coke oven gas is employed for heating, or even when producer gas is employed, although the chain of chemical actions may differ. Yet again, they may be caused if the heating gas is passed (as is done in some types of oven) through recuperative flues *en route* to the heating flue.

VIII.—Electrical Considerations.

Closely allied to the chemical and physical factors already mentioned is that of the discharge of solid particles carrying electric charges from hot bodies, notably carbon, the alkalies and alkaline earths and the metals. According to temperature these charges may vary in character from positive to negative. The most familiar example is that of the incandescent electric lamp having a carbon or metal filament, where the glass becomes blackened by the deposition of such particles. It is the blackening that limits the temperature at which the vacuum glow lamp can be worked, and an attempt to minimize this influence by filling the bulb with nitrogen constitutes the distinctive feature of the half-watt lamp. Sir Wm. Crookes has shown that by the electric furnace even the platinum metals can be vaporized, and the general phenomen has been investigated by Prof. O. W. Richardson in its electrical aspect. That gentleman framed an equation in conformity with the theory of electrons, and his experiments and equation have been discussed by the aid of other experiments. The conclusion reached is that this "electrical sputtering" is largely increased when gases are present that may interact with the heated body. Amongst these gases are the oxides of carbon, and the occluded gases in carbon. Under these favorable conditions quite large currents of electricity are set up, and as retort and coke oven conditions are very similar to these, it is a reasonable inference that electric influences must be reckoned with. Dr. Kaye has given photographs showing how the particles of metal may be removed by the electric current, leaving a distinctly pitted surface, even when gases are excluded from contact therewith. It would appear, therefore, that whilst chemical action occupies the first place in the disintegration and removal of silica and alumina, yet this may be supplemented at high temperatures by something akin to evaporation accompanied by electrical charges. The gases of the coke oven or retort—internal or external—will in turn be affected by these electrical charges, doubtless becoming ionized and having their chemical activity stimulated. If iron carbonyl is present, as possibly it may under certain conditions, being diamagnetic, it would be expected to behave differently to the remaining gases, almost wholly of the paramagnetic class.

IX.—Importance of the Water Used in Coal Washing.

This ionization of the gases may also be affected by the constituents of the water being distilled, and be accompanied by sympathetic action on the brickwork. Sir J. J. Thomson has found a radioactive gas—probably a mixture of two hydrocarbons—to be frequently present in well-water, but not in any of the numerous samples of rain and surface water that he tested. One component of this mixed gas had a density of about twice, and the other between six or seven times that of CO_2, and when cooled became liquid, having a very strong smell of coal gas. The gas can diffuse through a porous plate, and that it is a hydrocarbon was shown by spectroscopic examination by Mr. Newall. The gas extracted from the water retains its radioactive properties after bubbling through strong sulphuric acid or caustic potash, after passing over red-hot copper, or through a narrow platinum tube kept at a white-heat, and it does not seem appreciably affected when sparks are passed through it.

Seeing that most of the coal converted into coke in this country is first washed, and that at many colleries pit-water is used for the purpose, there is every likelihood of the behavior in the coke oven being affected thereby. Sir J. J. Thomson detected this radioactive gas most readily by its pronounced electrical behavior, and this property would at once ionize the gases in its vicinity and conceivably affect the solid surroundings.

It has been suggested that the corrosion of brickwork has been pronounced where the wash water at the colliery has been used over and over again, thereby becoming heavily charged with soluble salts, but the factor of radioactivity just mentioned may be an equally potent cause.

Construction of the Radio-X Lamp.

The construction of the Radio-X Unit, the new General Gas Light Company production, will appeal to every gas man. It has a single chain pull valve, the same in principle as those that have proven so successful and popular on all Humphrey Arc Lamps. Its action is positive and sure, and the position of the valve is always marked by a small indicating pin, convenient to the eye and fingers.

In the valve fitting is a double passage-way into the nozzle proper, in the centre of which is a simple, direct needle-point adjustment for the gas. The nozzle at the bottom of the fitting is removable, so that proper nozzle can be inserted for every gas pressure and other conditions.

The dome of the burner is a great innovation. Instead of the usual brass, it is made of porcelain enameled steel of finest quality, in color to match the shade or the decorations of the room. This porcelain enameled dome will not discolor from the heat or from contact with the products of combustion, and removes the greatest objection to all former single burners.

From the nozzle and through the top of the dome, the bunsen tube passes down to the burner proper. The bunsen tube is flanged at the top and threaded at the bottom, so that the nose piece receiver and lock nut screw onto it, and bind the valve, dome and burner together. The flange of the tube is notched to pass the pilot tube, which joins the valve fitting at the top of the dome through an ingenious union similar to a long threaded lock nut. The pilot tube terminates in a tiny lava tipped burner that directs the blue flame towards the mantle, and cannot be blown out.

Below the dome, the burner proper is encircled by a handsome ornamental one-piece band of brass, that carries the shade holder and provides the outlet for the heat and products of combustion. The ventilating outlets are so arranged that the products are thrown in an upward and outward direction, not coming in contact with the upper parts of the burner. One-quarter of the ring is left blank so that no products of combustion may escape beneath the fixture or goose neck, or the fresh air shutter which feeds the bunsen tube. This is an ingenious feature, as it is impossible for products of combustion to foul the air supply, which passes in through the intake, up through the dome, and is drawn into the bunsen tube properly heated, and it prevents discoloration of the fixture, for none of the heat and gases thrown off escape on the side under the fixture.

Into the nose piece receiver at the bottom of the bunsen tube fits the special porcelain nose piece that eliminates the necessity of extra screens, or other apparatus that tend to cause trouble by getting out of order. The nose piece is of standard lug type, for No. 8 ring mantle. The burner provides a convenient holder for a standard No. 3 lug inner chimney, and the strong, self-centering, spring shade holder will carry any standard glassware.

To take the burner apart, it is only necessary to screw up the long threaded union nut on the pilot tube, until the end of it passes the flange of the bunsen tube. The burner may then be unscrewed from the valve fitting and all parts are released without removing the valve, needle point or nozzle from the fixture.

Our Mineral Products.

The mineral products of the country are discussed in a small volume distributed by the United States Geological Survey, which contains a fund of information concerning the useful minerals and their production in all the States during 1912 and 1913. The figures given in some of the tables are so stupendous as to be almost beyond comprehension. The metal production in 1880 was $185,000,000, and increased to $883,000,000 in 1913: the nonmetallic minerals increased from $173,000,000 in 1880, to $1,562,000,000 in 1913; and the total mineral production from $365,000,000 to $2,446,000,000. The total for 1913 was an increase over 1912 of more than $200,000,000 in value.

A FLICKER PHOTOMETER ATTACHMENT FOR THE LUMMER-BRODHUN CONTRAST PHOTOMETER.

[By E. F. KINGSBURY, in "Franklin Institute News."]

Equality-of-brightness photometers and flicker photometers have heretofore been built entirely separate. In the literature of the measurement of light, the design and the use of the one has been a distinct problem from the design and use of the other, though the results the former gives are often used as a criterion for the practicability of the latter. Consequently the flicker photometer has been built from the beginning just for the one purpose, notwithstanding that about half of it is identical with an equality-of-brightness photometer in its essential requirements. It should be possible, by interchanging the dissimilar parts on the part common to both, to have either one easily converted into the other type. The result should be a photometer simple, compact, and capable of measuring either lights of one color or lights of widely different colors, with the precision of the equality-of-brightness method in the one case, and the flicker method in the other At the same time such an instrument should embody the latest approved features that are recognized as desirable in a flicker photometer.

It is the purpose of this paper to describe an instrument the author has devised, a flicker attachment to replace the telescope of the ordinary Lummer-Brodhun contrast photometer, when it is desired to measure differently colored lights. The high precision and the wide distribution of this type of equality-of-brightness photometer justify its selection for this purpose, although there are other good instruments to which the idea could be even more easily applied.

The various details of the attachment will be better appreciated if we briefly review the essential requirements of a flicker photometer.

Wilde says the desiderata of an ideal photometer are:

1. It must be sensitive and certain on lights of different colors.
2. Rays must fall upon the illuminated surface perpendicularly, to reduce angle errors.
3. Illuminated surfaces should be directly over pointer on the bar.
4. When balance is nearly obtained, it should be easy to perceive which way the head must be moved to improve the balance, without the necessity of rocking it to and fro.
5. If complete reversiblity is required, both illuminated surfaces should be identical, and must be the same distance from the eye.
6. In a flicker photometer, in order to secure sensitiveness, the transition from one surface to the other must be sudden, and there must be no dark line crossing the field of view, such as an unilluminated edge of a card.

These requirements are subject to considerable modification and addition, but are given as illustrating a certain viewpoint in the construction and use of flicker photometers, and to emphasize the employment of a proper photometric procedure.

The use of the substitution method of photometry is strongly recommended, with the direct measurement of distances wherever necessary.

This makes the second, third and fifth requirements unnecessary.

The fourth requirement is misleading, because one cannot obtain a satisfactory balance with the flicker photometer by merely looking at it in one position. The proper method of obtaining a setting is to vary rapidly the light intensity back and forth over the no-flicker peak, at the same time gradually narrowing the range until the point of minimum or no-flicker is found. The essential requirements only will be outlined below.

The sensitiveness or precision requirements of a flicker photometer depend fundamentally upon one thing—the focusing of the observer's maximum attention upon the elimination of intensity flicker. The attention is secured in a rather negative way by eliminating all external factors that can divert it.

First; undue tiring of the eyes should be guarded against, and is secured mainly by making the field surrounding the flickering field light instead of dark. The intensity of this illumination should be equal to, or less than, the intensity of the comparison field. If brighter, it attracts the attention. The intensity and color of this field do not seem to influence the accuracy, at least within wide limits. The field should be illuminated uniformly, and should be free from mechanical defects.

Secondly; there should be no mechanical flicker in the comparison field itself. This is secured by keeping the optical system clean and making its focus in space and not on a surface. The focus of the eye-piece lens, of course, should be on the plane of the opening through the external field just referred to.

Thirdly; in securing a balance, the color flicker (as distinguished from the intensity flicker) should be reduced to a minimum by a proper regulation of the speed of alternation of the colors.

The requirements that make for agreement with the equality-of-brightness method are in each method:

First, a restricted field; and

Second, a high illumination on this field.

Dr. H. E. Ives has found that on a field size of about 2°, and at an illumination of about 25 metre candles, the flicker method and the equality-of-brightness methods agree in their results, provided the same conditions are complied with. A restricted field and a high illumination are somewhat interchangeable, but the candle power of many standard lamps and other light sources places a limit on the illumination, so that the field is restricted to make it equivalent to a higher illumination.

The requirements having to do with procedure have been mentioned, namely, that the substitution method be used with the direct measurement of distances. Where it cannot be done, care must be taken to reverse the comparison head and also the lamps under test, unless complete reversibility of each has been shown to yield identical results.

The method of securing a balance with the flicker photometer mentioned above should be emphasized here. The relative intensities of the two lights under test should be capable of being easily and quickly varied over a considerable range. One method of doing this is shown below.

In making a setting the light should be varied back and forth over the region of minimum or no-flicker, and the limits gradually narrowed down to a balance. It is impossible to obtain good precision or accuracy by leaving the setting at any one point and trying to decide whether it is the correct point. There is no criterion for judgment unless the intensity is changed.

The last general requirement is convenience. The parts should be easily accessible for cleaning, repairing and demonstration.

The attachment, with the motor and a neutral tint-absorbing screen, is shown in position on a Lummer-Brodhun head in Fig. 1.

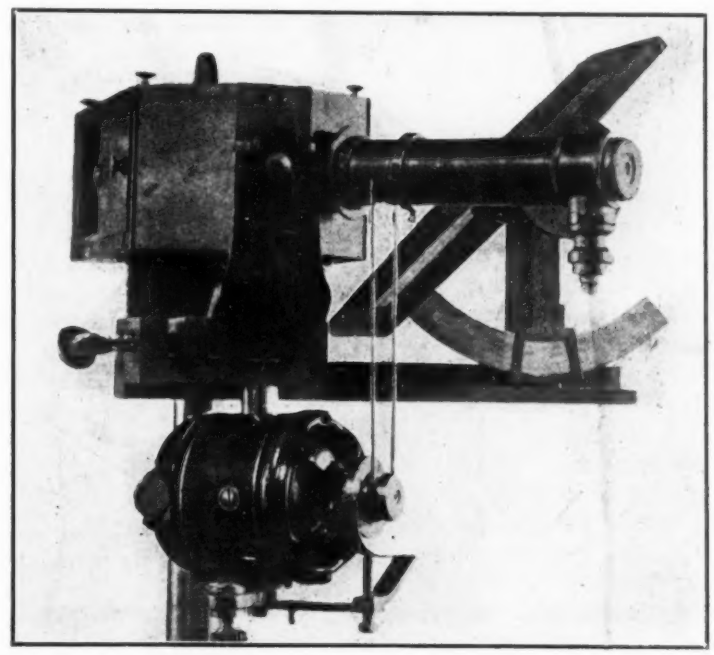


Fig. 1.—The Lummer-Brodhun with Flicker Attachment, Motor and Neutral Tint-absorbing Screen.

(*Continued on page 122.*)

THE AMERICAN GAS LIGHT JOURNAL

Entered at the Post Office, New York City, as Second-Class Matter.

Published Weekly at 42 Pine Street, - - - New York City.

Telephone Call, - John, 2996. Cable, - Am-Gas.

E. P. CALLENDER, - President and Treasurer.
F. A. SOUTHWORTH, - - - - Vice-President.
CHARLES H. WADELTON, Secretary and Manager.

SANFORD K. CAMPBELL, Editor.

NEW YORK, MONDAY, AUGUST 23, 1915.

Pertinent Facts on Safety.

The comparative safety of gas is well illustrated by figures taken from the report of the Fire Insurance Commission of Texas, dated April 19th, 1915. This report covers the particulars of 49,000 fires occuring in the State since December 10th, 1910, as reported to the State Fire Marshal.

The facts are usually very plain and clear. The statistics show with marked effect, the reliability of gas in the household, as contrasted with other sources of light and fuel.

The number of fires reported December 10th, 1910, to April 19, 1915 : Traceable to gas, 908; to electric current, 2,447 ; to gasoline and kerosene, 2,492. These figures are well worth consideration.

The number of fires caused by coal and wood stoves were, from stoves, 2,749 ; from flues, 3,996 ; from ashes, 940.

Coal and wood stoves, with their attendent flues and resulting ashes, have been responsible in about 4½ years for 7,685 fires, or 8½ times as many fires as were chargeable to gas in the same period.

Consider this enormous waste of money, time and material in this one State.

The answer is to make them " Use Gas."

Utilities and The People.

In an address before the Norfolk (Va.) Rotary Club, Mr. E. C. Hathaway, Assistant General Manager of the Virginia Railway and Power Company, discussed " Corporations and Municipalities and Their Reciprocal Relations." In his remarks he spoke of the daily press; saying, among other things slightly critical, the public service corporations are the only clients of the press who pay their good money for advertising space, and are criticised unmercifully in the same pages by men whose knowledge of the business is on a par with their familiarity with Hebrew and Sanskrit. Paraphrasing Lincoln's saying Mr. Hathaway added, " You can please part of the people all of the time ; you can please all of the people part of the time, but you cannot please all the people all the time."

Public service companies, in the last analysis, Mr. Hathaway declared, are business ventures, selling public necessities entering into our daily life. As they are always before the public, criticism is natural. It is unfortunate that in the majority of cases the stock in such companies is not held locally ; it should be held in the cities in which they operate. In the majority of cases electric railways, lighting plants and gas companies were originally local concerns, and were only fairly successful. The rapid growth of the towns made large expenditures necessary for extensions, betterments and improvements, and as the financing could not all be done locally, the stockholders sold out, usually at good profit, to syndicates that had the money-raising ability.

On the subject of what the corporations owe the public, Mr. Hathaway said that the obligation is clear. They owe the best service that can possibly be given, consistent with a fair return on the capital invested, and the proper up-keep of the property. Proper up-keep means the adoption of every modern device and improvement that makes for economy and efficiency to consumer and to the company. Good service does not mean just the quality and quantity of the product, but includes its delivery to the consumer, constant supervision to insure satisfaction, and proper hearing and attention to all complaints. Public education and sober thought are doing for the companies what they could not do for themselves ; therefore it behoves utilities to help this education by telling the people what they are doing, and what they expect to do in the future.

Announcement, Canadian Gas Association.

The Eighth Annual Meeting of the Canadian Gas Association will be held in Montreal, Quebec, on Thursday and Friday, September 16th and 17th. Headquarters will be at the Windsor Hotel, where ample accommodations are available for all visitors.

The morning of the 16th will be given over to a business session, and the presentation of some very interesting papers that have been prepared for the occasion.

On the afternoon of the 16th there will be a trip to the new Lasalle Gas Works, which should be of special interest to all gas men, as the new plant has been pronounced by many engineers one of the most up-to-date on the continent. Preparations have been made for the entertainment of the ladies by a trip up the mountain and through the parks.

On the evening of the 16th there will be a theatre party for the ladies, and a smoker for the men.

The morning of the 17th will be devoted to the presentation of papers and final business ; and at the conclusion of the session, members, visitors and ladies will be taken to the Golf Club for luncheon.

The Canadian Gas Association extends a very cordial invitation to all the gas men of Canada and the United States to be present, and it is hoped that there may be many visitors to the city.

The officials of the Association are, Howard E. Mann, President ; and John Keiller, Secretary-Treasurer.

Michigan Gas Association Meeting.

The 24th annual meeting of the Michigan Gas Association will be held in Detroit on September 23 and 24. The members, and any other gas men that can make it convenient to attend, are urged to get to Detroit early on the evening of the 22d, as an entertainment is planned for that night, and only two days will be given to the sessions, instead of three.

The list of papers already arranged for is as follows :

" High Pressure Distribution for Small Plants," by Ralph B. Wagner.

" Recent Developments in the Doherty Washer-Cooler and Condenser Systems," by R. B. Rowley of the Semet-Solvay Company.

" House Maintenance of Gas Lighting," by Wm. O. Weeks,

" A Talk on Accident Prevention," by Chas. B. Scott.

" A Talk on the Welfare and Training of Employees," by C. L. Palmer of Detroit.

Then there will be a contribution from Professor Alfred H. White and his assistants at the University of Michigan, who are in charge of the experimental and research work carried on by the Michigan Gas Association through its Fellowships. This is always of value and interest to everybody in the gas business.

The banquet will probably be on the evening of the 23rd, and some unusually interesting speakers and other entertainment has been arranged.

Further details can be had from Glenn R. Chamberlain, Secretary, Grand Rapids, Mich.

International Gas Congress Programme.

The list of papers so far prepared for the Congress is as follows:

Symposium "A Review of the Present Practices in the Manufacture and Distribution of Gas by British Undertakings," a contribution from the Institution of Gas Engineers of Great Britain through the late Mr. Edward Allen, engineer of the Liverpool Gas Company, consisting of an introduction and five papers:

"Introduction," Edward Allen.
"Carbonization," John Bond.
"Condensation, Washing and Scrubbing," Dr. W. B. Davidson.
"Purification," J. Ferguson Bell.
"Distribution," Walter Hole.
"Sale of Gas," F. W. Goonenough.
Paper (title unannounced), Dr. Charles Carpenter.

Symposium on "Illumination," consisting of six papers, arranged by Mr. C. O. Bond:

"Street Lighting," Geo. S. Barrows.
"Office and Store Lighting," O. H. Fogg and Thos. Scofield.
"Residence Lighting," W. A. Morris.
"Industrial Lighting," R. ff. Pierce.
"Semi-Public Lighting," T. J. Litle.
"Buoy and Car Lighting," George E. Hulse.

Symposium "Commercial Aspects of the Gas Business," from the National Commercial Gas Association, under the direction of Mr. C. Willing Hare:

"Public Relations," E. N. Wrightington.
"Office Management," C. N. Stannard.
"Complaint and Order Desk," W. J. Clark.
"Commercial Accounting," P. S. Young.
"Domestic Fuel Appliances," R. E. Slade.
"Domestic Lighting Appliances," J. D. Shattuck.
"Commercial Lighting Appliances," E. M. Colquhoun.
"Industrial Fuel Business."

"The Development of Water Gas," O. B. Evans.
"Deep Fuel Combustion as Applied in Water Gas Manufacture," Arthur G. Glasgow.
"Modern Coal Gas Proccesses," the Society of Gas Engineering of New York.
"The Substitution of Heating Value for Candlepower as a Standard for Gas Quality," R. S. McBride.
"Exposition Lighting," W. D. Ryan.

Up to the early part of August, the registration of those who will attend the Congress was not very encouraging, but great improvement has followed, and at this writing the prospects indicate a very satisfactory meeting, both in interest and attendance. For the benefit of those who are attending to details in San Francisco, it is important that registrations be made as promptly as possible. The attendance registration should be made with the Secretary, G. G. Ramsdell, No. 29 West 39th street, New York city; train reservations with Mr. B. J. Kellum, Master of Transportation, 631 Washington Boulevard, Chicago, Ills., and the hotel reservations with Mr. Geo. C. Holberton, Chairman of Hotel Committee, 445 Sutter street, San Francisco, Cal.

It is hoped that the members of all the Gas Associations, and especially those in authority, will not fail to appreciate the fact that the financing of the Congress depends upon the sale of the Proceedings. The papers to be presented, together with the discussion thereon, will undoubtedly be of such interest that the printed proceedings should be in the hands of every gas man, and in the library of every gas company. One large company has given an order for twenty copies for its department heads, etc., an example that should be largely followed.

As there will be no funds available to carry a stock of the volumes for future sales, the subscriptions received will decide the size of the edition. The Proceedings, it is now estimated, will cover 600 to 800 pages liberally illustrated, a volume up-to-date gas literature.

At a recent meeting of the International Gas Congress Committee of the Pacific Coast, Mr. Champ S. Vance, Vice-President of the Los Angeles Gas and Electric Corporation, and Past President of the Pacific Coast Gas Association, whose address is 645 South Hill street, Los Angeles, Cal., kindly offered his services as a representative of the International Gas Congress in Southern California, and announced that if any of the members of the International Gas Congress contemplated visiting Los Angeles, or the Exposition at San Diego, or returning East through Southern California, that he would be pleased to obtain hotel reservations, and supply any desired information concerning transportation or sight-seeing, for any member, or his family, who will notify him.

National Exposition of Chemical Industries.

Arrangements for the National Exposition of Chemical Industries, to be held at the Grand Central Palace, New York City, the week of September 12th, are progressing favorably, and over 50% of the main floor space has been reserved by exhibitors. Among these are many who will have working exhibits that will be unusually attractive. Many new things that were to have had their inception in the near future, will make their debut at this Exposition.

An auditorium will be provided with arrangements for motion and slide pictures for special features. Motion pictures of industrial and commercial plants will be shown, and various processes in operation; all of which will appeal to the technologist, and be of educational value to the general public. Lectures will be given in the auditorium by men of prominence in the chemical industries.

Meetings of the chemical, chemical engineering and engineering societies are being arranged for the week; that of the American Electrochemical Society, New York Section, on Tuesday, Sept. 21, promises to be an exceptional meeting. These society meetings should bring out unusual programmes, influenced by the critical situalion in which the chemical industries find themselves, and the impulses and stimulus given them by this situation.

An Exposition with so many deversified interests has never before been held, and a record attendance of technical men from the whole country is expected. Every one directly interested in the chemical industries is requested to send notice at once of their intention to be in New York for this Exposition, and the management will furnish, without charge, a season pass, good during their stay in New York.

An elaborate entertainment program has been arranged by the Entertainment Committee, including special sight-seeing trips around New York City. Arrangements will also be made by a Ladies' Receiving Committee for the entertainment of visiting ladies.

The Bureau of Foreign and Domestic Commerce, at Washington, is heartily in sympathy with the exposition, and contemplates an elaborate exhibit in conjunction with eight other Governmental Bureaus.

Encouraging Big Business But Not Utilities.

President Wilson in an address to the American Electric Railway Association, is quoted as saying:

"So I say that if your earning capacity is the capacity to earn the public confidence, you can go about your business like free men. Nobody is going to molest you, and everybody is going to say, 'If you earn big profits; if you have treated the people from whom you are making your profits as they ought to be treated; if you treat the employees, whom you use in earning those profits, as they ought to be treated; if your methods of competition are clear and above reproach; why, then, you can pile these profits as high as the Rockies and nobody will be jealous of it.' Because you will have earned them in a sense that is the handsomest sense of all."

These sentiments would be very encouraging to most any body of business men, except operators of public utilities. Their profits are held, by State regulation, to figures hardly remunerative, and even Washington influence will not help them.

(*Continued from page 119.*)

A Flicker Photometer Attachment for the Lummer-Brodhun Contrast Photometer.

Fig. 2 is an elevation of it.

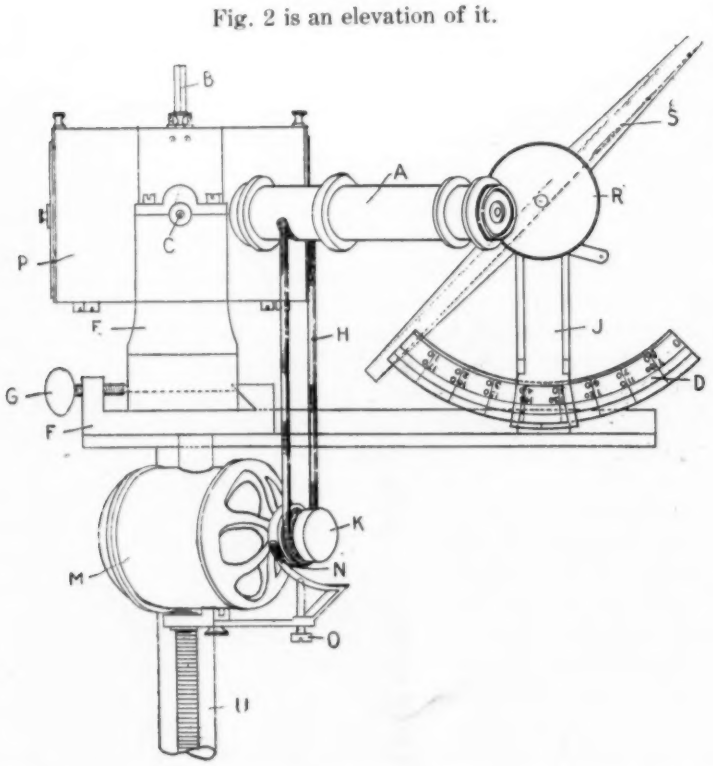


Fig. 2.—Elevation of Lummer-Brodhun with Flicker Attachment, Motor and Neutral Tint-Absorbing Screen, Showing the Method of Clamping It to the Head.

A. Flicker attachment.
B. Comparison disk.
C. Axis of head.
D. Scale.
E. Casting supporting head.
F. Clamp.
G. Clamp Screws.
H. Belt.
J. Index.
K. Pulley.
M. Motor.
N. Friction brake.
O. Brake screw.
P. Lummer-Brodhun box.
R. Screen knob.
U. Support.

The attachment *A* screws into the head, in place of the regular telescope. The only other change necessary is the removal of the contrast glasses, which the heads are built to readily permit. A belt *H* runs from the rotator within the tube to the motor *M*, which is fastened to a clamp *F* on the horizontal casting beneath the box. The belt *H* is a spirally wound steel wire, and acts as a spring to take up any slack, and allows of the belt being easily slipped off the motor pulley. The part shown to the right is an addition (proposed by Dr. H. E. Ives to facilitate reading), a neutral tint-absorbing screen formed of parallel wires in the frame *S*. The frame is turned by knob *R* and the transmission read on the scale *D*. This screen permits the light intensity to be easily and quickly varied over a considerable range, the desirability of which was mentioned above. In most cases it is more convenient to use such a screen than to move the light or the photometer head, though originally the attachment was intended to be used as the Lummer-Brodhun contrast head would. Dr. Hugo Kruss has a screen attached to his contrast photometer that would undoubtedly work nicely with the flicker attachment, if the micrometer thread is not too fine. *O* on the motor is a friction brake designed to allow the speed to be changed quickly and easily over a wide range.

The attachment is shown internally in elevation in Fig. 3.

The right end of the tube screws into the Lummer-Brodhun, and when the tube is in position, with the belt *D* downward to the motor, the collar *C* is screwed tightly against the box. This brings the attachment central and square on the head, and holds it rigid. *A* is a lens, in a collar *B*, that magnifies the Lummer-Brodhun field properly. *E* is a prism in a cylindrical piece, *G*, the whole rotated in bearing *H* by the belt *D*. The bearing *H* is held in position by a screw beneath the tube. Upon loosening this screw, the bearing, with the rotating piece containing the prism, can be slipped out of the tube, if the belt *D* is unhooked and pulled out. *K* is the eye piece, which consists of a brass tube, covered at the far end with a disk, *J*, in the center of which is the hole making the 2° field. The eye lens is at *P*, in a collar *Q*. The entire interior of the eye-piece *K* is painted white, and at *M* is a small 2-volt pocket torch-light, which, when lighted, sends its rays up in the eye-piece. This, being a matt white, acts as an integrating sphere, and diffuses the light so well that in looking into the eye-piece through the lens, one sees surrounding the 2° opening, a uniformly illuminated surface. To allow adjustment of the brightness of this surface to suit the observer, the socket *N*, into which the light sets, is fastened to a collar, *O*, which turns on the eye-piece *K*, and moves the lamp over the solid part of the eye-piece, the whole acting as a shutter. It allows of the illumination being from too bright to absolute darkness, and always keeping it uniform. A spring in the collar, *O*, pressing on the eye-piece, insures the collar turning smoothly. This collar can be slipped off the head of the eye-piece. The lamp socket, *N*, can be slipped out of the collar by loosening a set screw to replace the lamp. *L* is a collar on the eye-piece, that limits the distance it can be slipped into the attachment tube, and the turning collar, *O*, bears against it on the opposite side. When it is desired to remove the eye-piece, *K*, it is simply pulled out of the other tube, bringing *J* with it. The white surface is thus never exposed to careless handling. Fixed resistances, not shown, go in series with the lamp and motor. They are intended to operate on 110-volt line to the head.

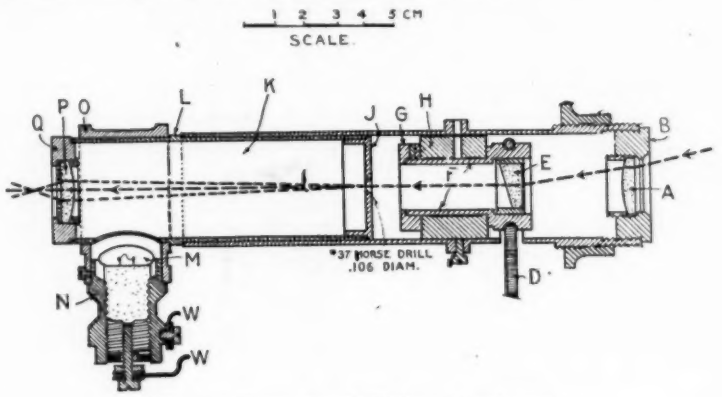
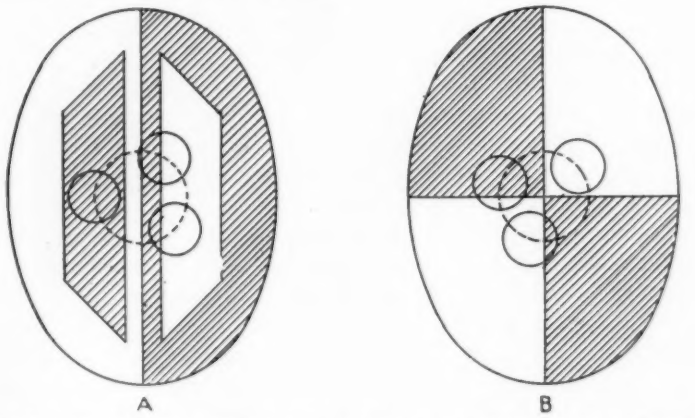


Fig. 3.—Elevation of Flicker Attachment.

A. Front Lens
B. Collar for lens.
C. Collar to hold telescope rigid to head
D. Belt.
E. Rotating prism.
F. Rotator bearing
H. Stationary bearing for rotator.
J. Front of eye-piece.
K. Eye-piece
L. Collar on eye-piece.
N. Lamp socket.
O Rotating collar for lamp.
Eye-lens.
Q. Collar for lens.
W. Wires to lamp.

The method of cutting the Lummer-Brodhun field is shown in Fig. 4, *A*. The dotted line shows how it goes from trapezoid to trapezoid, the circles representing three different positions of the rotating prism. *B* shows the four-part field used in the laboratory flicker photometer, recently built in this laboratory. This four-part cube can be easily put in a Lummer-Brodhun box to replace the present one, if that type of field is preferred. A question to be answered by this instrument was whether the irregular type of alternation, given by the Lummer-Brodhum field, would result in less precision or accuracy than the four-part field. No difference was found on trial, the irregular alternation of fields apparently calling merely for a lower speed.



To show how the Lummer-Brodhun field (*A*) is cut by the attachment; also a four-part field (*B*).

Fig. 4.

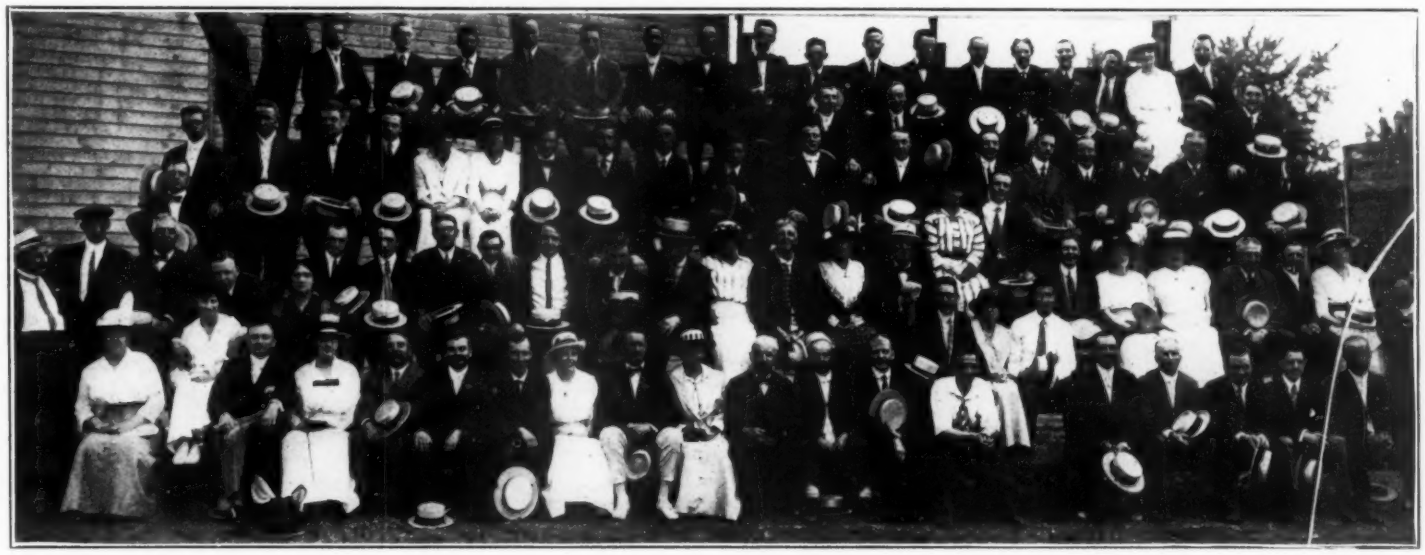
The real value of the instrument described is best shown in actually measuring large color differences. A deep red monochromatic signal glass, whose transmission was accurately known, was

measured against at 1.15 w.p.c. tungsten light on the other side; likewise a green signal glass and a 4 w.p.c. carbon lamp against the tungsten, In each case it has been found equal in precision and accuracy to the large laboratory instrument referred to. The focus of the optical system of the attachment is in space and not on a surface, and, although the attachment was tested on a photometer head whose mirrors were badly corroded and needed replacing, no trouble was experienced from mechanical flicker.

It should be made clear that this attachment does not obviate the necessity of a proper selection of observers, if the result is to represent that of an average eye. At least five observers should be used in that case, as has been explained in a paper recently published concerning this point, to which the reader is referred. This is required of all flicker photometers.

In addition to the above point, care should be taken to remove the contrast glasses of the Lummer-Brodhun in using the attachment. If this is not done there will always be an outstanding intensity flicker.

Outing of Hudson County Commercial Employees of the Public Service Company of New Jersey.



Upwards of 350 employees, with their wives and sweethearts, attended this outing at Midland Park, Staten Island, Saturday, July 10th, the first annual outing of the commercial employees of the gas and electric departments in Hudson County.

The idea of the outing originated in the Bayonne office, of which A. H. Glendinning is the agent, and F. W. Schmidt, Division Agent for Hudson County, gave his whole-hearted support to the project.

Five large cars were necessary to hold the merrymakers, and promptly at 12:30 the procession, with Tippett's orchestra asserting itself on the front car, headed for the park.

Upon arrival, a light lunch was indulged in, after which was the ball game, between the Bayonne District and the Jersey City District, Bayonne winning a hotly contested game. Another game that afforded much amusement was between the New Businessa Gs men and the New Business Electric men of the whole county, the former captained by G. E. Smith, and the latter by A. B. Spaulding. Although Spaulding's team lost by 9 to 2, he had the distinction of catching the only fly ball in the game. Mr. William E. Ward, of the Jersey City office, was the arbiter of the day, and he ruled with justice, tempered with mercy.

Then the races were run off and these afforded occasion for much excitement. Mr. A. H. Glendinning was official starter; E. Mercer, Judge of the course, and T. Tretheway, Representative Chairman of Athletic Committee. The results follow:

100 Yard Dash, won by H. Scott, Bayonne; Three-Legged Race, won by A. Henderson and H. Scott, Bayonne; Sack Race, won by W. Scott, Hoboken; Shot-Put, won by T. Tretheway, Bayonne, 36 feet, 3 inches; 220-Yards Race, won by J. Scott, Hoboken; Potato Race, Ladies, won by Miss McCoy.

The races over, all adjourned to the pavilion, where the picture was taken of the "bunch." The grand finale, a full-course shore dinner, was then "indulged," and in this, as well as the stunts, the boys showed their aptitude. Dancing was held later with Prof. Tippett's and his orchestra supplying the music.

World's Production of Petroleum in 1914.

The quantity of petroleum entering the markets of the world in 1914 amounted to 400,483,489 barrels, according to statistics compiled by the United States Geological Survey.

Of this record breaking output the United States is credited with 66.36%, approximately double the output of all other countries combined. Changes in rank during the year affected only Japan and Peru, the former superseding the latter.

The following table shows the world's marketed production of petroleum in 1914 and 1913, and the total output from 1857 to 1914, inclusive, in barrels of 42 gallons:

Country.	1914. Production.	Percentage.	1913. Production.	Percentage.	Total 1857-1914. Production.	Percentage.
United States	265,762,535	66.36	248,446,230	64.59	3,335,457,140	59.63
Russia	67,020,522	16.74	62,834,356	16.34	1,622,233,845	29.00
Mexico	21,188,427	5.29	25,902,439	6.73	90,359,869	1.62
Roumania	12,826,579	3.20	13,554,768	3.52	117,982,474	2.11
Dutch East Indies	12,705,208	3.17	11,966,857	3.11	138,278,392	2.47
India	8,000,000	2.00	7,930,149	2.06	73,979,919	1.31
Galicia	5,033,350	1.26	7,818,130	2.03	131,873,601	2.36
Japan	2,738,378	.68	1,942,009	.51	27,051,158	.48
Peru	1,917,802	.48	2,133,261	.55	14,306,972	.26
Germany	995,764	.25	995,764	.26	12,965,569	.23
Egypt	777,038	.19	94,635	.03	1,086,728	.02
Trinidad	643,533	.16	503,616	.13	2,069,430	.04
Canada	214,805	.05	228,080	.06	23,493,610	.42
Italy	39,548	.01	47,256	.01	802,229	.01
Other countries	620,000	.16	270,000	.07	1,322,000	.03
Total	400,483,489		384,667,550		5,593,262,936	

Fire-Place Heater Design Competition.

Several months ago a joint committee was appointed by the American Gas Institute and the National Commercial Gas Association, to hold a competition for a gas fire-place heater design.

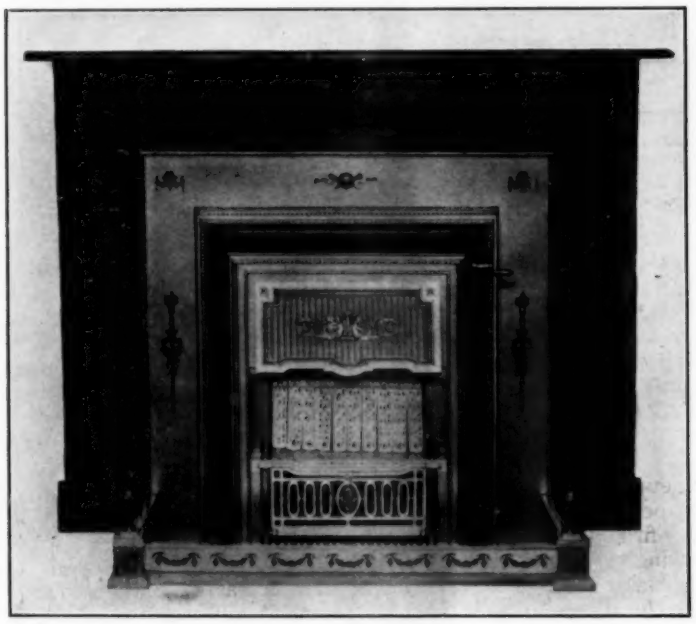
The competition is now closed, and as announced in the JOURNAL two weeks ago, the winner of the competition is a firm in Rotterdam, Holland, known as R. S. Stokvis & Zonen, Ltd., who submitted several designs, two of which are shown in the accompanying illustrations.

There were 17 competitors, who submitted from one to six designs each, and the decision of the jury was arrived at after a very careful consideration of all the points. The jury were three well known Philadelphia architects.

The following extracts are from the letter making the award:

"The undersigned, appointed as architects to serve on the jury for the competition instituted by the American Gas Institute and the National Commercial Gas Association, for a fire-place heater burning gas, beg to report that, after a careful examination of all the designs submitted, and a thorough study of the problem, we are prepared to recommend that the award of the prize be made to the design marked 'Exhibit B,' submitted by R. S. Stokvis & Zonen, Ltd., Rotterdam, Holland.

"In arriving at this conclusion, we have taken into consideration the following conditions referred to in the program:



"1st. That the heater should be artistic in appearance, both when lighted and unlighted.

"2nd. That the heater shall be designed for a fire-place, and shall be a device distinctly for the burning of gas.

"3rd. That the heater shall not be an imitation of a wood or coal fire."

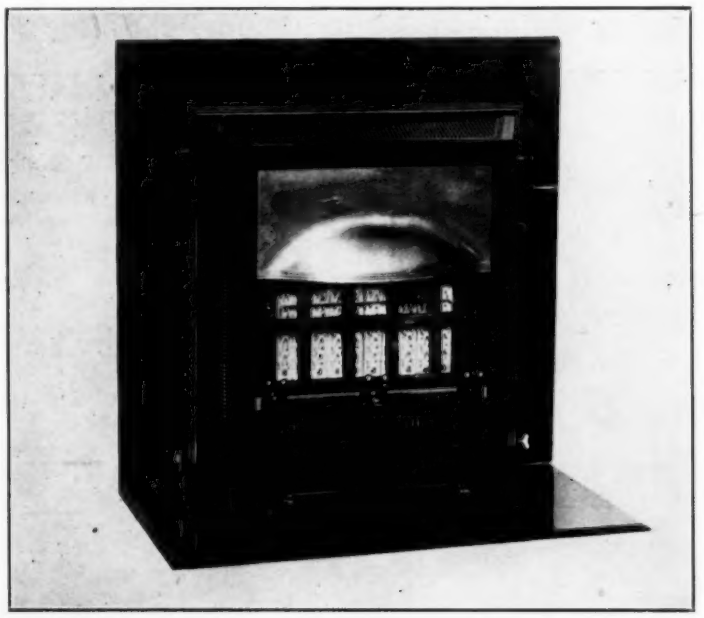
Referring to the winning design, they say:

"We find that it has artistic merit, and will have a good appearance both when lighted and unlighted. It depends on gas only for fuel. It is designed to fit in an open fire-place with a flue to carry off the products of combustion, and its designers claim a form of flue construction that allows the greatest efficiency from the combustion of the gas, and entirely prevents the escape into the room of products of combustion. It radiates direct heat from a ceramic material heated to a bright red by bunsen burners, and most of the heat is given off in the radiant form. It is also provided with a series of vertical tubes, which, when heated by gas flames, produce indirect heat by warming air entering at the bottom of the heater and passing out at the top and sides. The device of a mica screen makes it possible partially to moderate the heat, and, when the heater is not lighted, offers an opportunity for an artistic screening of the front. We consider that the design of this heater offers interesting possibilities in the development of its details."

They also refer to "several of the designs that are worthy of mention, and in a measure they follow the principles of the fire-place to which the award was made, but fall short of it in excellence."

Special mention is made of one design, which was excluded from consideration because it is not really a gas heater:

"———, nevertheless, on account of its artistic design and its possibilities in connection with heating problems in general, we think it worthy of a separate mention. The principle of this design is that of a grille, that will allow the passage of warm air through it, and which, becoming heated, actually radiates heat. It could be used as well in connection with a steam or hot air heating plant as with a gas burner."



Referring to the winning design, which is briefly described in the quotation from the award, attention is called particularly to the movable screen, which may be made of mica or other material of artistic appearance, and which will serve, not only as a screen, but will protect the ceramic material from the accumulation of dust when the heater is not lighted.

Attention is called by the successful competitor to the fact that this appliance should be connected with a chimney for the purpose of ventilation, but that the chimney draft is not essential for proper operation of the gas fire. While this heater is primarily of the radiant heat type, the circulation of air about it gives a good deal of heat of convection, the competitor saying that the temperature of the air issuing from the passages is between 400° and 500° Fahrenheit.

The design referred to by the jury in their special mention, may be placed in front of a luminous flame heater that does not require a flue connection, and which, therefore, may be available in rooms where flues are not installed; although, in the opinion of the joint committee, this practice is not to be encouraged.

Some of the other designs are quite similar in principle to that of the winning competitor, and all are interesting.

Further information regarding these designs, and the addresses of the various competitors may be obtained by communicating with Mr. W. J. Serrill, Chairman, Joint Committee on Fire-place Heater Design.

Recent Patent Issues.

Prepared for the AMERICAN GAS LIGHT JOURNAL by ROYAL E. BURNHAM, solicitor of patents and counselor in patent causes, 833 Bond Building, Washington, D. C., from whom illustrations and specifications of any patent mentioned below may be obtained for 20 cents.

1,144,783. Combustion Apparatus. A. Rector, New York City, assignor to Rector Gas Lamp Co., same place.

1,144,788–9. Apparatus for Producing Gaseous Fuel. F. M. Rites, late of Slaterville Springs, N. Y.; C. H. Gallagher, executor of said Rites, deceased, assignor to R. C. Rites, Ithaca, N. Y., guardian of Marion B. Rites.

1,144,800. Apparatus for Manufacturing Carbureted Hydrogen Gas. B. van Steenbergh, Goshen, N. Y.

1,144,977. Apparatus for Manufacturing Coal Gas. H. Bruce, Baltimore, Md., assignor to The Bartlett Hayward Co., same place.

Correspondence.

[The JOURNAL is not responsible for the opinions expressed by correspondents.]

Carbolineum and Creosote.

New York, Aug. 17, 1915.

Editor, AMERICAN GAS LIGHT JOURNAL: DEAR SIR—The letter of July 28th, 1915, from S. R. Church, manager Research Dept., Barrett Mfg. Co., I have carefully read.

In the first place, Mr. Church, in advancing his ideas of wood preservation, states that: "The whole theory of wood preservation is based on the injection into the wood of substances of toxic character." Mr. Church fails, however, to advise that the substance used should remain permanently in the timber, and that neither the preservative nor the method of treatment should have an effect upon the initial strength of the timber.

A confirmation of the facts as set forth in your previous issue, of the relative values of Carbolineum (anthracene oil), and Creosote, as a permanent and efficient wood preservative, demonstrated by examination of well-preserved timbers after from 25 to 45 years service, can be had from the reports of Professor Gellert Alleman, employed by the United States Department of Agriculture as an expert on this subject.

The injurious results from creosoting treatment are characterized in an article in the "Engineering News" of October 29th, 1914, extracts from which are as follows:

"The August, 1914, bulletin of the American Railway Engineering Association is entirely given up to a paper by H. B. Macfarland, Engineer of Tests, Atchison, Topeka & Sante Fe Railway, entitled 'Tests of Oregon Fir Piling.' The object of the tests was to determine the effect of the steaming process of creosoting, as practiced on the Pacific Coast, upon the physical properties of the piling. Mr. Macfarland states that tests have been made demonstrating that the physical structure of Oregon fir piling is decreased considerably by the boiling process of creosoting; but claims have been made that the steam creosoting plant did not deteriorate the physical strength of the material except, possibly, on the outer surface. These statements were based on a small number of small size tests, so the railway decided to make a large number of tests on both full-size piles and on small pieces cut from piles."

The general conclusions are as follows: "In every case the treated material shows a decided loss of strength as compared to untreated. The greatest loss is in transverse strength, due to the influence of treated sap-wood. The loss of compression strength is considerable."

Mr. Church's statement, that "the truth is that commercial creosote oil will penetrate further into wood than the oil ordinarily known as carbolineum, under any method of treatment, etc.," is not substantiated by the tests at the Forest Service Laboratories, which are reported as follows:

	Penetration Radial and Tangential.		Longitudinal.	
	Maximum inches.	Minimum inches.	Maximum inches	Minimum inches.
Coal Tar Creosote.....	0.28	0.23	6.00	5.30
S. P. F. Carbolineum....	0.37	0.23	6.00	5.70

As to the product of the "Creosote Well," this has been referred to by so many writers that it seems unnecessary to dwell on it further, except to refer to scores of Forest Service bulletins and circulars confirming the writer's previous statement. The specifications of the various societies referred to, are all specific in their requirements, and do not admit of suppliers furnishing oil from the "Creosote Well" at their pleasure. Users of these or other specifications are not "unsuspecting buyers," but quite the reverse.

According to "Wenzel's Official Directory of Chemical Industries in Germany in 1908," there were 52 different manufacturers of carbolineum in that country alone. This does not include manufacturers in other countries.

Carbolineum, when one understands that it is not the name of a proprietary article, and that the word, according to such authority as Lunge, is a refined anthracene oil such as is required by the specifications adopted by the American Telephone and Telegraph Co., the United States Navy, No. 52-C-2, Jan. 2 1915, and others, has been accomplishing results for over 40 years, and the constantly increasing use and application of it on larger and larger projects indicates in a most practical and substantial way that open-minded engineers are coming more and more to appreciate the advantages of Carbolineum over Creosote, both from the financial standpoint, as well as a means of avoiding the known failures of creosote and present-day methods of treatment of wood with it.

In 1902 the "Harriman Lines" put in a test installation of railroad ties, which were under observation until 1907, and as a result, every traction road in, and radiating from, Salt Lake City, is using or will use Carbolineum-tested ties.

Two large railroad systems on the Coast, namely, the Oregon-Washington Railroad and Navigation Co., and many divisions of the Southern Pacific Co., are using Carbolineum-treated ties and wood paving blocks under their heaviest traffic conditions, and, in some cases, under conditions where creosote has failed.

Two years ago the Puget Sound Division of the C. M. & St. P. R. R. decided to try some method of tie treatment other than creosote, because of the mechanical disintegration of the creosoted ties that had been used on some of their bridges, and which had lasted less than 2 years.

These three instances are some of the "big fellows;" and at present there are five traction companies, conveniently near New York City, who are treating their ties in their own inexpensive plants, with Carbolineum. Truly yours, H. H. ALCOCK.

New Methods and Appliances.

STANDARD SPECIFICATIONS FOR CEMENT.—(*Year Book of Amer. Soc. Testing Materials*, 1914.)—*General Conditions.*—All cement shall be inspected and at least 12 days allowed for inspection and testing. A bag of cement shall contain 94 pounds of cement net; and each barrel of Portland cement shall contain four, and of natural cement three bags of above net weight. Cement failing to meet the seven-day requirements may be held pending the results of the twenty-eight-day tests before rejection. All tests shall be made in accordance with the methods of the American Society of Civil Engineers. Acceptance or rejection shall be based on the following requirements:

Natural cement is defined as the finely-pulverized product resulting from the calcination of an argillaceous limestone at a temperature only sufficient to expel the carbonic acid gas. *Fineness.*—Not more than 10% by weight to be left on a No. 100, and not more than 30% on a No. 200 sieve. *Time of Setting.*—At least 10 minutes for initial set and from 30 minutes to 3 hours for hard set. *Tensile Strength.*—The minimum requirements for briquettes one square inch in cross-section are given in the table; no retrogression in strength must be shown within the periods specified. *Constancy of Volume.*—Pats of neat cement about 3 inches in diameter, 0.5 inch thick in centre, and tapering to a thin edge, shall be kept in moist air for 24 hours, and subsequently shall remain firm and hard, and show no signs of distortion, checking, cracking or disintegration when kept in air at normal temperature or in water at about 70° F. (21° C.) for at least 28 days.

Portland cement is defined as the finely-pulverized product resulting from the calcination to incipient fusion of an intimate mixture of properly proportioned argillaceous and calcareous materials, and to which no addition greater than 3% has been made subsequent to calcination. *Specific Gravity.*—Not less than 3.10. If a sample fails to pass, a second test may be made on a sample ignited at a low red heat; the loss in weight on ignition shall not exceed 4%. *Fineness.*—Not more than 8% on a No. 100, and not more than 25% on a No. 200 sieve. *Time of Setting.*—At least 30 minutes for initial set, and from 1 to 10 hours for hard set. *Tensile Strength.*—See table; same conditions as for natural cement. *Constancy of Volume.*—Same as for natural cement, with the addition that a third pat is exposed in an atmosphere of steam, above boiling water, in a loosely closed vessel for 5 hours. Not more than 1.75% SO_3 and not more than 4% MgO.

Age.	Tensile strength of			
	Natural cement.		Portland cement.	
	Neat.	Mixed with 3 parts of standard Ottawa sand.	Neat	Mixed with 3 parts of standard Ottawa sand.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
24 hours in moist air.....	75	...	175	...
7 days (1 in moist air, 6 in water)..	150	50	500	200
28 days (1 in moist air, 27 in water).	250	125	600	275

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE Jacksonville (Fla.) Gas Company has found it necessary to increase their coal gas capacity, and are filling three empty arches with Gas Machinery Company type of chamber retorts. The erection work, which was started by the Gas Machinery Company early in July, is well under way, and the benches will be ready for operation at an early date. On completion of the three benches, Jacksonville will have six benches of Gas Machinery Co. type D shaped inclined retorts and six benches of the same company's inclined chamber retorts. The inclined chamber retorts are regarded very favorably by the Jacksonville Gas Company on account of the high grade of coke produced.

OVER a hundred gas works in France have raised their price for gas in consequence of the great rise in the price of coal. The increases authorized are mostly in the neighborhood of 25 cents per 1,000, through some are as low as 3 cents, and others are as high as 55 cents, or even more.

THE official list of awards to exhibitors in the Collective Gas Exhibit at San Francisco, makes five corrections in the list of awards published in the last issue of the JOURNAL. The Consolidation Coal Company was awarded a Medal of Honor, which is the highest award possible; the Western Gas Construction Company received a Gold Medal for tar extractors; and P. H. & F. M. Roots Company were given a Gold Medal. In the honors to collaborators, Leon B. Jones has a Gold Medal, and D. E. Keppelmann received a Silver Medal.

THE many friends of A. H. Strecher will be glad to learn that he is about recovered from a five weeks' illness.

So insistent has become the demand of the Allied European Governments for haste in filling an order for over a million camp stoves, given some time ago, that the Reznor Stove Company has issued a notice to its employees that hereafter there will be no Saturday afternoon holiday, and that the working day would be increased a half hour. The demand that the Allies's contract be entirely filled before the cold weather sets in resulted in the order.

CHAS. S. GRAVATT has been appointed general manager of the Reliance Gas Mantle Company, 320 Pearl street, New York City. Mr. Gravatt was very successful last year in placing large contracts with some of the most important gas companies, where the question of gas arc maintenance is of considerable moment.

THE City Commissioners of Sea Isle City, N. J., have offered the Seashore Gas Company $10,000 for the gas plant at that resort.

Two feet of brick work was knocked from the stack of the Boston (Mass.) Consolidated Gas Company by a bolt of lightning that did no further damage.

CAST iron pipe advanced last week 50 cents per ton following the advance in pig iron, Quotations f. o. b. Birmingham are $21 for 4 inches and $19 for 6 inches and upward for water pipe, with $1 added for gas pipe. Makers report a steady demand and operations on an 85% capacity. The tendency is to advance prices still higher.

THE Laconia (N. H.) Gas and Electric Company has purchased the Weeks block, so-called, and is to make a number of improvements on the building, where it will establish its main office.

GEORGE S. FOREST sold the Iowa Falls Gas Company property to C. O. Jones, of the Jones & Hovey Company, of Independence, the new owner taking over the business the first of August. The management of the company will remain in the hands of Supt. Frank S. Kramer, who has been with the company for a number of years.

ONE of the recent triumphs of gas arc lighting is represented by the lamps that illuminate the clock in the tower of Independence Hall, Philadelphia. W. A. Heine, who has charge of all the city clocks, perfected a regulating system whereby the lamps are automatically lighted at a given hour in the evening, and extinguished in the morning. The arrangement consists of a train of wheels connected with the main shaft that drives the hands of the clock. Connected with this mechanism is an index plate, with markings for each hour of the 24, and movable fibre blocks for turning the lights on and off. The lighting system consists of a five-mantle Humphrey arc in front of each of the four dials, and a reflector of burnished metal.

A BALTIMORE newspaper says: "Patrons of a down town dining room, at noon yesterday, saw a well-dressed young woman, in immaculate white, with a large handbag, enter and walk back toward the kitchen. They did not know she was entering a new field, that had heretofore been occupied solely by man. She was a full fledged gas range inspector, one of many female inspectors doing daily duty in the department of household economics recently established by the Consolidated Gas, Electric Light and Power Company. She was answering a hurry call and the kitchen force was surprised to see her, as they expected to see a man in overalls, carrying a kit of tools. It chanced that the range was too hot to be attended to just then, so she gave some directions for repairing it and left."

IT is announced that gas rates in De Kalb, Ills., were reduced to $1.20 net on August 1st, and that they will be further reduced to $1.15 net January 1, 1916.

A SUIT brought against the Aetna Life Insurance Company was won by the Portland (Ore.) Gas and Coke Company, when Federal Judge Bean handed down a decision carrying with it judgment of $5,916.72 with interest and costs. The suit was the outgrowth of seven cases of typhoid fever that developed among workmen employed by the company in the summer of 1913. The workmen made demands upon the company, which had liability insurance with the Aetna. The insurance company declined to pay, on the grounds that typhoid fever was not within the policy, but the gas company settled with the employees.

THE formal papers in the transfer of the property controlled by the United Gas Improvement Company to the Waterbury (Conn.) Gas Light Company have been filed. These are all quit-claim deeds of property acquired by the U. G. I. Co. during the time it was in control of the Waterbury gas plant. The Waterbury Gas Company always owned the gas plant, but after the United Company leased the property, it acquired considerable other property in extending its improvements. The Waterbury Gas Company has now purchased the greater portion of this property.

AT a hearing to investigate the city lighting department of Minneapolis, Minn., Mr. F. C. Shepherd testified that a leak in a gas pipe in the office of A. D. Meads, City Gas Inspector, which had been ineffectually plugged with soap, cost the Minneapolis Gas Light Company $12,000 in rebates, in March, 1910. "The gas we were furnishing tested 22 or 23 candle power," said Mr. Shepard, "but the city gas inspectors gave us credit for only 15 or 16. When I was ordered to find the reason, I inspected the city's photometer. With the light in the instrument turned off, the meter continued running. I then examined the pipe and found the leak plastered with soap. The soap had dried and cracked and the pipe leaked. Telling me I had no business in there, Mr. Meads than ordered me from his office."

THE Old Colony Gas Company have applied for a franchise to furnish gas to the town of Hull, Mass. Should this franchise be granted, the company will extend its present mains in Hingham down through the beach section and Hull.

THE Philadelphia Suburban Gas Company is laying mains to supply extensive real estate developments in the new communities of Bywood and Springfield, near Lansdowne, Pa.

A ST. JOSEPH, Mo., paper says, "that as a result of of the incessant rains, the big holder of the St. Joseph Gas Company, at Fifth and Cedar streets, has settled to the southwest, and measurements made by engineers show it to be about 4 inches out of plumb. The holder was built in 1912, and it has a capacity of 3,000,000 cubic feet of gas, and the tank contains 6,000,000 gallons of water."

THE Fall River, Mass., aldermanic committee on street lights recently took a journey to Boston, and A. M. Brown, District Manager for the Welsbach Street Lighting Company of America, showed them places in the vicinity of the Hub where that company has charge of the gas lighting system. The company has made a proposition for taking over the gas lighting system in Fall River.

THE People's Gas and Electric Company, Chillicothe, Mo., has signed a five-year lease on the building on North Locust street now occupied by them. The building will be brought up to date and a modern front installed.

THE Associated Press tells Chicago that gas meters in New York City henceforth will be read by photograph. The gas company believes this will assure absolute accuracy. Meter readers employed by the company will be equipped with small cameras that fit over the dials on the meters. By pressing a button, light is thrown on the dial and an exposure made, showing the amount of gan burned.

MINOT, N. D., is to have a gas plant in the near future.

THE plant of the Bessemer (Ala.) Gas Company, which is to be sold to the Birmingham Railway, Light and Power Company, according to plans now under consideration, was inspected last week by George Bullock, Chairman of the Board of the United Gas and Electric Engineering Corporation, which owns the Birmingham Railway, Light and Power Company. The sale of the Bessemer plant to the Power company has been contemplated for some time, and an announcement concerning it is expected immediately. When the deal is closed the plant will be greatly improved.

FRED M. LEGE, Jr., who has been general manager of the Brush Electric Company and the Galveston Gas Company, has resigned his position with the former company, but will remain in charge of the gas company, which was recently purchased by Electric Bond & Share interests. Mr. Lege will also have a prominent place in the operating organization of the Electric Bond & Share Texas properties. M. R. Phipps has been appointed general manager of the Brush Electric.

THE streets of Millenocket, Me., are without light. Mr. Moore has been running the gas plant on a losing basis for some time, and he now feels that he can no longer keep it up. At the last town meeting he offered to give the plant to any one who would take it and furnish the gas for the town, but no one seemed at all anxious to accept the proposition. There is enough carbide on hand to furnish gas until the close of the month it is thought. It will be hard to go back to kerosene lamps, but that seems to be the only thing in sight just at present.

THE directors of the New Bedford (Mass.) Gas and Edison Light Company have issued expressions of their appreciation of the late George R. Stetson. The resolution adopted was as follows: "Mr. Stetson became president and general manager of the company in 1890, and for more than twenty years worked with indefatigable energy and industry to promote its success. Under his management the company enjoyed a high degree of prosperity, and became one of the most stable financial institutions in the community. He was sincerely interested in the welfare of every individual connected with the company, and was respected and beloved by the whole organization. A man of firm convictions and decided opinions, he was vigorous in argument and sometimes strenuous in controversy; but his warm heart and kindly nature were never wholly hidden, and there were few, if any, opponents who left the contest bearing any feeling of personal hostility or ill will, A strong character, a good man, a useful citizen—his associates will long remember him as all of these; but they will also remember him as a genial, kindly friend, full of spirits and good feeling, with a hearty greeting and a cheery word for all."

M. L. HIBBARD, General Manager of the Union Light, Heat & Power Company, Fargo, N. D., was recently re-elected a member of the Board of Directors of the Merchants Auxiliary of the North Dakota State Fair Association; and W. P. Chestnut, New Business Manager of the Company was elected Secretary-Treasurer of the Auxiliary.

UTILITIES COMMISSION NEWS.

UTILITIES BUREAU CONFERENCE ON VALUATION.—Under the auspices of the Utilities Bureau a conference on principles and methods used in the valuation of public utilities will be held in Philadelphia, on Nov. 10 to 13. Among those who will take part are Milo R. Maltbie, Clifford Thorne, John M. Eshleman, Charles A. Prouty, Edward W. Bemis, Delos F. Wilcox, John H. Gray and Max Thelen.

The bureau, of which Mr. M. L. Cooke, of Philadelphia, is acting director, was founded at the meeting of Mayors of cities, in Philadelphia, last November. Volume 1, No. 1, of the *Utilities Magazine*, has been issued. It is stated to be "one medium through which the Utilities Bureau will give to officials and city residents information of interest and usefulness in utility matters."

Other articles are on "The Right of a Plaintiff to Examine the Books and Properties of a Utility Company," by Mr. Harold Evans; "Public Utility Problems and the Municipality," by Mayor Ira W. Stratton, of Reading, Pa.; an abstract of the decision of the New York Public Service Commission, First Dictrict, in the case of Stadtlander et al. versus the New York Edison Company, by Mr. Cooke, and "Pasadena's Municipal Light Plant," by Mr. C. W. Koiner.

ELECTRIC COMPANY NOT A MANUFACTURER.—In the United States District Court, Judge Witmer, in dismissing a creditor's petition for the adjudication of the affairs of the Wilkes-Barre (Pa.) Light Company, handed down the opinion that a company engaged in generating electricity is not a manufacturer, nor is it a merchant when it sells its energy, and that, therefore, the company did not commit an act of bankruptcy while insolvent, by applying to the court for the appointment of a receiver. The decision, in part, is as follows:

"I record myself with those of the opinion that generating electricity is not manufacturing, nor is the directing of electricity over lines of wires to consumers, for a consideration, a mercantile pursuit within the meaning of the bankruptcy act. The company has the right, to a certain extent, of exercising eminent domain, and is, therefore, correlatively charged with a duty to the public which is no part of the duties of an ordinary corporation engaged in manufacturing, trading, printing, publishing, mining or mercantile pursuits. It is a utility corporation by necessity of the law creating it as such; an impress of this character is influenced by statute, and though municipal consent may be withheld for a time, as in the case before us, the end or character of the corporation is not changed, nor is it dependent on the action of the municipality conferring or vacating the right of public franchise. The Legislature has also stamped the character and nature of this class of corporations upon their charter, and by the act of July 26, 1913, defines a public service company without reservation as including electric corporations."

QUESTIONS JURISDICTION OF COURT.—A motion to quash the summons in the injunction recently granted by Judge Thomas J. Flannelly of the Montgomery county district court, restraining the Kansas Public Utilities Commission from putting into effect its revised schedule of prices for gas sold by the Kansas Natural Gas Company, has been filed in the district court on behalf of the commission.

The commission's attorneys assert in their motion that the district court has no jurisdiction over the members of the utility commission, because the commissioners' homes and offices are in Shawnee county and not in Montgomery county.

The order against which Judge Flannelly granted an injunction increased the price of gas sold by the company in Kansas from 25 to 28 cents a thousand cubic feet. The company is now in the hands of receivers, attorneys for whom contend in the injunction proceedings that the 3 cent increase is not enough, as the company could not sell gas for a profit at 28 cents a thousand cubic feet.

COMPETITION IN UTILITIES CALLS FOR HIGHER RATE OF RETURN.—The Indiana Utilities Commission in fixing rates to be charged by the Indianapolis Light and Power Company, said: "An examination of the records kept by the company and its predecessors disclose that large earnings have been gathered into its treasury. From these earnings there has been invested in the property a large surplus taken from the people. If it enjoyed a monopoly this invested surplus in the property would justly reduce the returns on this property to 6%. But in its field of operation it has a strong and vigorous competitor, and the rate of return should be larger because of this fact."

Financial Notes.

PROPOSALS for the $25,000 issue of the Westfield (Mass.) Gas Electric Light bonds were opened by Town Treasurer Searle at Westfield. The bonds were sold to N. W. Harris & Co., of Boston, who offered 101.58 and accrued interest. There were sixteen other bidders.

THE BLACKSTONE VALLEY GAS AND ELECTRIC COMPANY has declared its regular quarterly dividend of $2 a share, payable Sept. 1, to stockholders of record Aug. 20, 1915.

THE report of the CONSOLIDATED GAS, ELECTRIC LIGHT & POWER CO., of Baltimore, for the year ended June 30, 1915, is now being prepared and will be ready for distribution about October 1. It is understood that it will show a satisfactory gain in earnings over the preceding fiscal year. In June, 1915, the company made a gain of 174 gas customers and 332 electric customers. In June, 1915, 331,022,700 cubic feet of gas were sold as compared with 324,902,600 cubic feet in June, 1914. Output of electricity for June, 1915, was 10,858,967 kilowatt hours, as compared with 10,309,595 kilowatt hours in June, 1914. The company announces the regular quarterly dividend of 1¾% on its common stock, and the regular semi-annual dividend of 3% on its preferred stock, both payable Oct. 1, to stockholders of record, Sept. 15.

THE WILMINGTON GAS COMPANY has declared the regular semi-annual dividend of 3% on its preferred stock, payable Sept. 1.

THE increased activity in Massachusetts gas stock recently has resulted in swelling the list of stockholders until it has touched the 5,000 mark, for the first time in the history of the company. The number of preferred stockholders has also increased to a new high record of over 7,000, of which 656, or 9% are employees of the Boston Consolidated Gas Company, who own 3,506 shares, which were awarded them under the profit-sharing plan.

THE ASSOCIATED GAS AND ELECTRIC COMPANY, in its report for the twelve months ending June 30, 1915, shows gross earnings of $659,537, a decrease of $20,510 from the previous year. Net earnings were $259,315, against $276,510 in 1914; the total surplus, after paying the dividend on the preferred stock, was $20,349, a decrease of $218 since 1914 The month of June showed an increase in gross earnings of $217 from the $50,322 of 1914; net earnings went up $1,109 to $21,000 for 1915, and the total surplus, after paying preferred stock dividends, changed from a deficit of $94 to $1,147.

THE OHIO CITIES GAS COMPANY declared a dividend of 1¼% on common stock, payable September 1 to stock of record August 14.

A PHILADELPHIA syndicate headed by Mr. Edward E. Mandeville is forming a merger of gas, power and light companies in New York, according to papers filed with the Public Service Commission, Second District. The company will be known as the ORANGE COUNTY PUBLIC SERVICE COMPANY, and will control the Orange County Company, the Cuddebackville Company and the Monticello Light & Power Company, covering the cities of Middletown, Monticello and Port Jervis, as well as the towns of Cuddebackville, Otisville and Howells, with a population of nearly 40,000. The syndicate controls the Port Jervis Light & Power Company and the Port Jervis Traction Company.

THE COMMONWEALTH POWER, RAILWAY AND LIGHT COMPANY, Jackson, Mich., reports earnings for the years ended June 30, 1915 and 1914, as follows:

	1915.	1914.
Earnings from stocks from subsidiary companies	$2,382,175	$2,463,861
Interest and other earnings	500,519	517,823
Gross earnings	$2,882,692	$2,981,684
Expenses and taxes	104,316	114,508
Interest charges	602,700	659,842
Total deductions	$707,016	$774,350
Net income available for dividends, replacements and depreciation	$2,175,676	$2,207,334
Dividends on preferred stock	960,000	960,000
Balance	$1,215.676	$1,247,334

THE sale of the DOVER, ROCKAWAY AND PORT ORAM (N. J.) GAS COMPANY by Willard W. Cutler, special master, was adjourned for one week at the request of counsel in the case. It was said that Addison Ely, who controls the corporation, is making efforts to secure capital to continue the present organization. The sale is under foreclosure proceedings by the stockholders.

DIVIDEND NOTICE.

THE AMERICAN GAS COMPANY,
WEST WASHINGTON SQUARE,
Philadelphia, Pa., Aug. 18, 1915.

A quarterly dividend of 1¾ per cent., or $1.75 per share, has been declared on the capital stock of this Company, payable Sept. 1st, 1815, to the stockholders of record at 3 o'clock P.M., Aug. 18th, 1915. Checks will be mailed.

2098-1 J. B. TOWNSEND, 3d, Treasurer.

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